SCIENTIFIC AMERICAN

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1. Metal peak of the clock tower now being erected at the works at Tacony. 2. Statue of William Penn; height, 36 feet. 3 The Market Street façade. 4. Present condition of the tower (height about 350 feet). 5. Appearance of the building showing tower completed.

GREAT TOWER OF THE CITY HALL, PHILADELPHIA—TOTAL HEIGHT, 547 FEET.—[See page 357.]

Scientific American.

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NEW YORK, SATURDAY, JUNE 6, 1891.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 805.

For the Week Ending June 6, 1891.

Price 10 cents. For sale by all newsdealers.

ANNUAL CONVENTION OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

Floating from the tall tower of the Lookout Inn, 1,700 feet above the city of Chattanooga, a large white flag bearing on its blue field the letters "A. S. C. E." assured us, on our arrival, that in the parlors below the American Society of Civil Engineers was in session. This was their twenty-third annual convention, which opened on the 21st of May. Fully 250 members, associates and guests, were in attendance, hailing from all parts of the United States, with a fair delegation from Canada, not only civil engineers, but also those representing the various departments of engineering, military, naval, mechanical, mining, and electrical. A special train from New York, with recruits from various points along the route *via* Cincinnati, brought more than a hundred passengers, while others came singly or in small parties. Our own trip was by the charming Shenandoah Valley route, which gave us an opportunity to see the marvelous growth of a portion of the Old Dominion once utterly wasted by the ravages of war, but now both blooming and booming. So extensive indeed are the rival speculations of Charlestown, Riverton, Luray, Shandun, Basic, and other ambitious places, that one of our party aroused the ire of some of the boomers by asking why they did not stake out as city lots the whole valley from Harper's Ferry to Roanoke. It is noteworthy that this actual and prospective growth, whatever its real value may be, is due to Virginian enterprise, and not to an infusion of Northern energy. In this respect, we had a series of surprises at Chattanooga, Nashville, Atlanta, and Birmingham.

It is hardly practicable for a full report to be given of the proceedings and discussions of this learned society, guided by President O. Chanute, of Chicago, and Secretary F. Collingwood, of Elizabeth, N. J. Some papers were very long, and others bristled with technical and statistical matter, but again there were many novel and special features that might excite the interest of any person of ordinary intelligence and public spirit, and the mention of which will show that, besides much social enjoyment, a great deal of hard work was done between May 21 and June 1. We naturally begin with the

PRESIDENT'S ANNUAL ADDRESS.

In rehearsing the main engineering achievements of the year, President Chanute gave great prominence to what has been done in the way of completing several remarkable tunnels, most of which have had more or less notice already in these columns. The new Croton Aqueduct, a rock tunnel 30 miles long, with a capacity of 318,000,000 gallons per day, was completed last July, after five years boring and at a total cost of $23,561,973. It is in charge of Mr. A. Fteley, vice-president of this society. The successful driving through of the tunnel beneath the St. Clair River at Sarnia, for the Grand Trunk Railway, under the direction of Mr. Hobson, of the A. S. C. E., is an achievement that will inaugurate an era of special activity in works of a similar character elsewhere. It is 6,000 feet long between the portals, 2,290 feet being under the river proper. It was driven through soft clays by a cylindrical steel shield forced forward by 24 hydraulic rams. Under cover of the cutting edge men excavated the material, working night and day, most of the time in compressed air. The lining is of segmental rings of cast iron, whose flanges are bolted with oak packing, making a tunnel 21 feet in diameter. Less than an hour was taken to swing and bolt each ring, under a sliding rim. The rams worked independently, and with such accuracy that after a year's driving at the rate of 8 feet per day, the two shields coming from opposite directions met exactly in line and level, having at no time varied more than two inches from true position. Meanwhile work is resumed on the Hudson River tunnel at New York, and it is decided to drive a tunnel at Detroit in lieu of a bridge. The great subway tunnel for the City and South London Railway, extending under the Thames, and 3¼ miles long, was opened to the public November 4, 1890, and has met with such favor that a number of similar projects are in the field, both in England and America. The various systems used are but modifications of the Greathead method, of which Beach's pneumatic shield was the prototype. Reference was also made to the drainage tunnel for the valley of Mexico, 9·76 miles long, now being driven through indurated volcanic mud, being the "tebebate" through which Martinez, in 1608, drove a drainage tunnel 4 miles long in 11 months, with crude appliances and Indian laborers.

Mr. Chanute's address next treated of marine affairs. Our commercial fleet on the lakes demands, for its greatly increased tonnage, deeper water. There will soon be a navigable depth of 20 ft. from Duluth to Buffalo. A ship railway 66 miles long is advocated between Lakes Huron and Ontario, whence there should be a sufficient enlargement of river and canal to insure a navigable depth of 20 ft. from Chicago to the ocean. Freight rates to Liverpool would thus be reduced nearly one-half. The cost of this scheme would be about $43,000,000.

Another project is to join Lake Erie with the Ohio River by ship canal from Conneaut to Rochester on the Ohio, so as to give a depth of 14 ft. to Pittsburg, for steamers of 1,500 tons. This would cost $27,000,000, and is recommended by the Pennsylvania Legislative Commission.

Still a third project is to enlarge the Chicago River and upper Illinois, already united for drainage purposes, so as to give a depth of 14 ft. to Joliet, thus making, indirectly, an important ship canal, at a cost of $20,000,000, with the expectation that the government will make its connection with the Mississippi practicable.

In speaking of ship railways, mention should be made of the invention, of which a working model was shown, by Mr. William Smith, at Edinburgh, in 1890, that admits lateral and vertical motion of the trucks without communicating it to the ships. The model gave satisfaction to naval experts and may effect a great reduction in the cost of locating ship railways.

There were built in the United States, in 1890, about 6,344 miles of new railroad, giving an aggregate of 167,741 miles, or 44 per cent of the total railway mileage of the globe. North America has in all 187,425 miles; South America, 16,000; Europe, 141,000; Asia, 20,000; Australia, 13,000; and Africa but 6,000. Americans are clearly the railway builders of the world, and should do missionary work for the rest of mankind. Our improved methods of operation have kept pace with progress of construction. As one item, 150,000 of our freight cars are equipped with Westinghouse automatic air brakes, which are ordered for 500,000 more, and 102,000 have the Master Carbuilder's automatic car couplers. Locomotives have gone on from the primitive Rocket, of 4½ tons, with one pair of driving wheels, to the Decapod type, with ten drivers and 80 tons weight, and Shay's plan of working an indefinite number of drivers. There is a limit, however, in this direction, as the weight of our engines and cars may be so increased as to crush or rapidly grind the best rails.

Mountain railways were described, especially that on Pike's Peak, and also a novelty styled the Hydraulic Sliding Railway. The fact was commented on that in 1890 the United States, for the first time in its history, had produced more iron and steel than any other nation. The remainder of the president's admirable address was occupied by a description of remarkable bridges and commercial structures recently built, with excellent lantern illustrations.

IRRIGATION.

An entire morning was devoted to hearing and discussing a paper by Herbert M. Wilson on American Irrigation Engineering, an art of such recent development that the majority of creditable works of that class are but just approaching completion. Experienced engineers were not employed on the early works of Colorado and California, and the cost for repairs has made the financial results disappointing. One notable instance of blundering was the Florence Canal, in Montana, 15 miles long and 20 ft. wide, whose bottom has never been wetted since its construction in 1888. But now a dozen canals are completed, or under construction, with bed widths of 50 ft. to 70 ft., with main lines from 50 miles to 100 miles long, with as many more miles of laterals, and having capacities varying from 1,000 to 1,500 second-feet. Such canals will irrigate from 100,000 to 150,000 acres each, and will render habitable twice that area, supporting on an average 3,000 families each. The only European work comparing with ours in size is the Cavour Canal, in Italy. Indeed, our works are second only to those of India, from which they differ in four essential points: ownership and legislation, engineering, construction, and superintendence and maintenance. Some of our most troublesome complications arise from questions of ownership. Then, again, many of our canals, instead of being made through gently sloping or level land, are constructed on steep mountains, excavated from rocky walls of cañons, carried through costly tunnels, or across wide and deep valleys. Instead of governmental works, as in India, and the details carefully elaborated with regard to permanence, our main object has been to build cheaply and quickly. For example, the Del Norte Canal, 60 ft. wide and 5½ ft. deep, with 30 miles of mains and as many more of distributaries, with its weir, gates, and other works, was built in 110 days. Rightly viewed, there is less excuse for faulty work on an irrigation system than on a railway; for a far greater amount of property and a larger number of liver are imperiled by mistakes. We have no proper system of control for completed canals as they have in India. We have, until recently, paid little attention to the hydrographic questions involved; but now they have been taken up by the irrigation branch of the U. S. Geological Survey and by several of the Western State agricultural colleges. It is not possible, in a condensed report, to give the results of varied experiments as detailed by Mr. Wilson. His account of the pioneer canals and their results was interesting. Then the canal systems of the various Western States were described. By far the most magnificent canal in our country is that of the Turlock district, so outlined that all its 176,000 acres can be watered from the same

source. The works of the San Diego Flume Co. and of the Folsom Water Power Co. were described, as were also the Sweetwater, Merced, Cuyamanca, and Castlewood reservoirs, in which water is stored to supplement the flow of intermittent streams. An interesting problem, as yet but partly solved, is that of securing a correct and uniform standard for measuring water sold for irrigation. The meter used in cities cannot be applied to open ditches, as it would soon be clogged.

Apropos to the subject was a memoir on

WATER METERS,

by Mr. John Thomson, in which was ably set forth an array of facts drawn from personal knowledge and experience, with illustrations, tables, and data from a great collection of "meter literature," showing what a surprising amount of capital, thought, time, and labor have been given to this branch of hydraulic engineering. During the last fifty-three years, to the close of 1890, the United States has granted 678 patents in this class, while Great Britain has granted 231 patents, and France, Belgium, and Germany 250, making a grand total of 1,159 meter patents; and yet, to the question, Has any generic invention of marked importance been made in water meters during the past twenty years? the prompt answer is, No. The meters in market, here and in Europe, are those that have survived that period, or are modern adaptations of old devices. Broadly, there are but two types, one on the displacement, the other on the inferential principle, the cylinder and piston illustrating the former, and the gauge the latter. Amid confessed perplexities it seems certain that compact low-priced "rotaries" will supplant the more cumbrous and expensive forms, and that a perfect meter must be as nearly frictionless as possible. Mr. J. R. Freeman argued that for measuring the discharge of water in moderate quantity and under pressure, a simple smooth nozzle to which an accurate pressure gauge is connected forms a meter of great convenience and accuracy. His experiments with nozzles up to 2½ inches in diameter are claimed to demonstrate their utility in this respect for all ordinary purposes. The principle, of course, would hold good for large conduits, provided the conditions were practicable.

Engineer Grainor's paper on the "Origin and Evolution of the

RAILROAD VIADUCT"

was an attempt to trace historically the progress made from the primitive trestle, whose timbers rested directly on bents of two legs cross-braced, up to the modern typical American viaduct, whose spans are supported at each end by towers composed of two or more bents braced together in all directions, being really a combination of a series of independent piers, with spans of truss connecting the same.

We are so accustomed to the familiar plan of cross-ties that it seemed odd that any one should argue for the superior advantages of a "Longitudinal Bearing System for

RAILWAY TRACKS;"

and yet Mr. T. C. Clarke's paper on that topic elicited a more lively discussion than almost any other communication presented before the convention. He admitted that the common plan had done well in the past, but had now to be modified to meet the ever-increasing weight of cars and engines, which has nearly doubled during the past 15 years. Our tracks are giving out at all points. Even steel rails are not hard enough; their ends are battered, or the material itself flows under the heavy wheel loads. Sawing rails loosen the spikes. The timber supply is becoming a serious question. From sixty to seventy million ties are annually required in the United States. Rails, spikes, ties, are all failing together. Remedies as proposed, *e. g.*, the iron chair on every tie, are expensive; so are steel cross-ties, which also sink at the joints, making an uneven track. The plan is therefore advocated of returning to the old form of a continuous rail and a continuous bearing, improved to avoid the defects found by experience. Some of these defects were pointed out, but none of them seemed so radical and remediless as the low joints of the cross-tie system. Figures were shown to prove that a first-class track, made with metallic longitudinal bearings, need not exceed the cost of one laid with metallic cross-ties, and would be better and more durable. Mr. E. E. R. Watman, of the *Engineering News*, commented at length and with great ability on Mr. Clarke's paper; as did also Mr. Shinn and President Chanute. The final impression made was that our American tracks are by no means as safe and durable as they ought to be.

A paper previously read by Julian A. Hall, on the

"RIGHT OF WAY

for Railroads," was ably discussed by ex-President Shinn. Among other good points made was the claim that railroads should have maps accessible for ready reference, showing, first, the alignment through the county; secondly, that through the first township of the county; then successively, and on an ample scale, maps describing each piece of property crossed. These should be kept in a suitable book. Another book should be made, with an index, minutely describing the nature of title, whether by purchase, gift or condemnation. No agent should be allowed to close any bargain without official approval. Substantial monuments should be fixed to show exactly where the right of way lies. The legal and the engineering departments should work together; and every deed should be indorsed both by the engineer and the counsel before it is accepted.

Among

OTHER PAPERS ON THE PROGRAMME

were those on "Sections and Mechanical Conditions of Car Wheels," by P. H. Griffin; "Stresses in Railway Bridges on Curves," by Ward Baldwin; on "Cements, Mortars, and Concretes," by Wm. U. Grant; "Steam Heating," by Wm. E. Worthen; "Free Railways *vs.* Governmental," by E. B. Dorsey; "The Straits of Juan de Fuca," by B. W. De Courcy. Some of these were read by title, but others brought out full and interesting discussions.

The venerable James B. Francis, of Lowell, Mass., was some time ago appointed as chairman of a committee to report on the cause of the

JOHNSTOWN DISASTER,

but his report was delayed lest it might unduly affect pending suits. At this meeting, however, it was presented, being briefly that the "spill-way" of the South Fork dam had not been made according to the original plan as laid down by Engineer W. E. Morris, but was reduced to less than half its proper width. The result was that the waste water did not have an opportunity to run out at the time of the flood, and, therefore, ran over the top of the dam and washed the earth away, thus causing the fearful disaster that followed, and that could not have taken place had the original plan been carried out as it should have been.

An extremely interesting lecture was given on the local geology of the region surrounding Chattanooga, with maps showing the structure of Lookout Mountain and the adjacent hills. The writer also gave an illustrated description of the stalactitic caverns of Virginia. A memorable excursion was made down the Tennessee River for fifty miles, between the Raccoon Mountain and Walden's Ridge, to a station on the Memphis and Charleston Railroad, called Shellmound, on account of the ancient "kitchen middens" in the vicinity. In the base of the Raccoon Mountain, only half a mile away, and exactly on the line between Tennessee and Georgia, lay invitingly open the enormous mouth of the famous Nicojack Cave, one of the few true rivals of Mammoth Cave. Of course a party was made up to explore its mysterious depths.

The social enjoyments of the convention call for notice before closing. Probably there is no set of men in our country who do more hard work than these same civil engineers. Who would blame them if they had a jolly time when they assemble at their annual convention, in addition to reading and discussing "papers"? Lookout Mountain abounds with magnificent views, commanding literally an outlook into seven States, and on every side were interesting historical localities, to which due attention was paid. The week's work wound up with a splendid banquet, served at the Lookout Inn, the cost of which was defrayed by the members themselves. The next annual convention will probably be in Boston.

DOMESTICATING CAMPHOR TREES IN THE UNITED STATES.

Although the camphor tree is a native of China, Japan and Formosa, the authorities of the United States Department of Agriculture state that it has been a subject of distribution by the department for nearly thirty years. It is a very ornamental plant and has been used to some extent as a shade tree. The trees thus distributed are grown from seeds, the plants being raised in the nurseries of the department. The camphor tree flourishes in perfection in some of the Southern States, especially along the Gulf coasts. It grows rapidly from the seed, and the Department of Agriculture has frequently received seeds from this source which, when sown in a garden border, as a common garden pea is sown, rapidly vegetate and form plants from eighteen inches to two feet in height the first season. While the camphor tree flourishes best in warm climates, it will stand 20 degrees of frost without being injured, and any locality where the thermometer does not show lower than 20° F. is fitted for the growth of the plant. A large number of trees were raised by the U. S. Department of Agriculture in 1877 from seed sent from South Carolina, where trees are growing. Plants obtained from this seed were sent into the Southern States mainly as ornamental or shade trees. It was found that it answered well as a shade tree, especially in Florida, though not much was expected of it in the way of producing camphor as a commercial product.

Interest in the growing of camphor trees has recently been stimulated by the great increase in the price of gum camphor. This advance was caused by the quantities of the article which have been used in the manufacture of smokeless powder, and also by the increasing demand from makers of celluloid goods both in this country and in Europe. Before the introduction of celluloid goods about all the uses to which camphor was put were the preserving of clothing and fur goods from the depredations of moths, and in medicine, but now large quantities of the commodity are used in celluloid manufacture, and for the production of smokeless powder. The principal source of supply is in Southern Japan, and the method of extracting the gum from the wood was fully described in the SCIENTIFIC AMERICAN of April 5, 1890. The methods used in this process, as was then shown, are of an exceedingly primitive character, and this has prevented any material increase in the supply of camphor to meet the increased demand. In April, 1890, machinery was constructed at Pittsburg, Pa., for distilling camphor by more rapid processes, and this was shipped to Hiogo, Japan, but no advices have yet been received of the success of the experiment. The price of camphor is still maintained at a high figure, which will probably have the effect of still further stimulating the interest in the domestication of the tree in this country, with a view to extracting the gum for commercial purposes. Twelve months ago not less than five thousand plants were sent out by the Department of Agriculture from the gardens at Washington, and many thousands of plants are now growing there from seeds sown three months ago.

The method pursued by the department in disposing of the trees is to send them to parties applying for them, who reside in sections of the country where the trees are likely to do well, and suggestions are also made to certain persons to take the trees, experiment with them, and report. The following is a statement from a person who had been thus favored: "A camphor tree received from your department, six years ago, has grown up into a fine tree, some fifteen feet in height. It is a very ornamental tree, and is valuable on that account alone, but if this is the tree from which the camphor of trade is obtained, I would be obliged if you would inform me how to get it. I have tried cutting the bark, but could not see any exudation of gum."

Camphor is generally obtained from the tree by chopping the wood and roots into small pieces and boiling them with water in an iron vessel till the camphor begins to adhere to the stirring utensil. The liquor is then strained and the camphor concretes on standing. It is afterward mixed with a finely powdered earth, and sublimed from one metallic vessel into another. In Japan the chips are boiled in a vessel to which an earthen head containing straw has been fitted, and the camphor sublimes and condenses on the straw. Crude camphor very much resembles moist sugar until it is cleaned. The refining process by sublimation requires care and experience.

There is a tree found on the island of Sumatra which furnishes an oil called camphor oil, which is obtained from incisions in the tree. Solid pieces of camphor are also found in the cracks of the wood, which is usually obtained by felling the tree, cutting it into blocks which are split and the camphor extracted. This article is rarely met with in commerce, and the tree is too tender for the climate of the United States.

The Department of Agriculture will have a large supply of camphor trees ready for distribution next spring, inquiries having been received from many localities, regarding the domestication of the tree in this country.

Camphor trees have done well in California. A tree in Yuba County, in fourteen years, reached a height of fifty feet. One recommendation of the tree for ornament alone is its exemption from insect parasites, which, especially in the coast regions, trouble all indigenous evergreens and materially stunt their growth.

WHY DOES SOLID IRON FLOAT ON MOLTEN IRON?

This question, which has puzzled a good many observers, was satisfactorily explained by Dr. Anderson in a recent paper on steel read before the Iron Institute, London. When a piece of solid iron is thrown into a pot of molten iron or steel the solid metal at first sinks, which shows that its volume is less than the melted metal. But soon the solid piece becomes heated, which causes it to expand, its volume is increased, and it rises and floats on the surface of the molten mass. The action is the same both with iron and steel. Mr. Wrightson said:

"The experiment was frequentiy made by throwing a piece of iron into melted steel. They could see it go down, and might think that it was on account of the impetus which the iron had attained in falling that height, but as a matter of fact if the iron were put upon a fork and lowered, it would go down; but in the course of a few seconds it came up again, and kept on expanding until the piece of iron was a considerable distance above the surface of the metal. Then it decreased in volume, and of course became of the same volume as the molten metal which it joined. Any one could see by the distance that the piece of iron went above the surface that it was of considerably less density than the molten metal."

NEW EMERY WHEEL DRESSER.

Any one who has ever had anything to do with emery wheels knows that the efficiency of a wheel depends upon the condition in which it is kept. Good work cannot be done with a wheel covered with ridges or hills and valleys, and, besides this, an untrue wheel is sooner worn out than a true one. For these reasons, to say nothing of the wear and tear of the machine in which the wheels are used, it is essential that every user of an emery wheel should have some efficient means of dressing them, so as to always keep them in working order.

We give an engraving of an emery wheel dresser which has given excellent satisfaction. It consists of a cutter made from the best tool steel carefully hardened, having a cellular structure formed by series of radial conical holes. This roller is journaled in a suitable handle, which is provided with fingers for catching on the rest of the grinding machine. With this construction the roller or cutter may be brought to bear on the periphery of the emery wheel with any desired pressure. The cutter rolling in contact with the wheel soon reduces the surface to the required working condition.

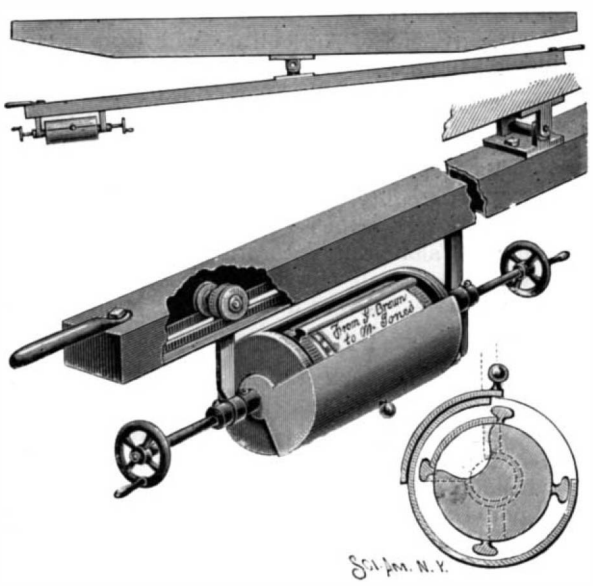
THE STANDARD EMERY WHEEL DRESSER.

This cutter has the advantage over all others in remaining efficient so long as any of it remains.

This useful tool is made by the Standard Tool Co., of Cleveland, O.

A CAR RECEIVER FOR BILLS OF LADING, ETC.

A device for use on railway cars, providing a convenient receptacle for condition cards, bills of lading, etc., and so constructed that the contents will be kept clean and be readily accessible when required, is shown in the illustration herewith. It forms the subject of a patent issued to Mr. George W. Turner, of South Omaha, Neb. The device is suspended beneath the car, preferably on a pivoted rail having a handle at each end, whereby it may be accessible from either side of the car. A cylindrical shell or jacket has an opening at one side normally closed by a semicircular cover, the shafts forming the pivots for the side ears of the cover being journaled in each head of the shell. On the outer end of each shaft is a hand wheel, and the inner ends of the shafts are attached to a drum adapted to be rotated within the shell by means of the shafts. The drum has longitudinal ribs on its periphery, each having an undercut recess in its side faces constituting slideways. Between one or more of the ribs, as shown in the sectional view, is a chamber covered by a lid fitting in the slideways, the chamber being adapted to receive documents. The surface compartments on the peripheral surface of the drum between the ribs are adapted to receive condition cards of defects or other cards containing usual notices or information, such cards being held in position in their several compartments by having their side edges entered into the slideways. The drum may be revolved by either of the end shafts, to bring the inner end of any desired chamber or compartment into register with a semicircular jacket slot, concealed by the jacket



TURNER'S STORAGE RECEPTACLE FOR CARS.

cover when closed. The rail from which the device is suspended is preferably made of a single piece of metal, rolled to form two spaced tracks to accommodate four or more grooved wheels arranged in pairs. The rail is closed at its ends by buffer blocks or their equivalent, and to prevent the shell or jacket from turning, one hanger is provided with an angular foot at its lower end, engaging lugs on one end of the shell.

ACCORDING to Census Bulletin No. 66, the total number of vessels on the great lakes December 31, 1889, was 2,784; the total gross tonnage, 924,472; and the total net tonnage, 780,119. The estimated carrying capacity of these 2,784 vessels was 1,254,271 tons, and the commercial valuation was $48,809,750.

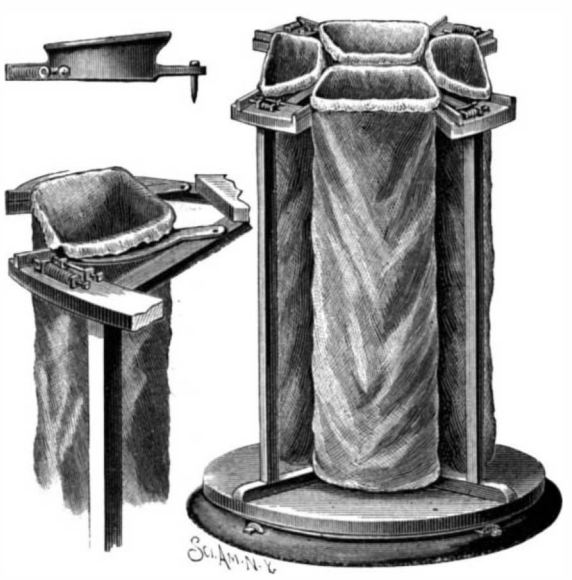
Internal Strains in Masses of Steel.

Visiting, in 1886, the several works at and near St. Etienne, where the chrome steel projectiles were being produced, their successful manufacture being then of comparatively recent date, I saw, at more than one establishment, a large number of projectiles which had sustained spontaneous fracture. In one store where the finished shot were stacked, after the lapse of the period during which the tendency to the development of cracks or to rupture was stated to diminish gradually, I saw the head of one out of a pile of projectiles which had quite recently been projected to a distance of many feet by the violent spontaneous rupture of the metal. Instances of the development of flaws in these projectiles are now, so far as our experience at Woolwich goes, exceedingly rare, and the remarkable power possessed by these formidable punching tools of penetrating 8 to 10 inches of armor without even sustaining any important alteration in dimensions is a convincing proof of the uniformity of structure and mechanical stability of the highly dense and tenacious material of which they are composed.

The importance of rest in bringing about a diminution, if not the entire disappearance, of internal strains in masses of metal, is illustrated by the behavior of these chrome steel projectiles, which, at any rate in the earlier days of their manufacture, it was found necessary to store for several months before their transport to a distance could be ventured upon. My report of 1865 on this subject gives illustrations of the recognition, already at that period, of the effect of time in establishing chemical equilibrium in masses of metal. Thus, the United States government had then recently instituted comparative experiments with iron guns newly cast, and with others produced at the same time, but preserved for lengthened periods, which demonstrated the importance of attention to this matter; and the object aimed at and attained by Rodman in his proposal to cast iron guns of large caliber upon a core instead of solid, and to cool the castings as rapidly as practicable from the interior, while retarding the cooling from the exterior, was to diminish the severity of internal strains set up in the cooling masses of metal, and to reduce the period of time required for the establishment of mechanical equilibrium in the castings. My old friend, the eminent chemist, Thomas Graham, who was Master of the Mint when this subject was under examination by me, wrote me a very interesting letter in October, 1865, on the subject of his experience of the tendency to the development of cracks in steel dies; and after mentioning that eight dies out of 200 which had been stored, after having been passed as thoroughly sound, had recently been rejected as having developed cracks, he stated that they had sound reason at the Mint for believing in one peculiarity of tempered steel dies, namely, that if kept in store for a year or two, they became less apt to crack when in use, and coined more pieces than dies newly tempered. The possible existence of internal strains in masses of steel composing the tubes or barrels in which it may be said that the real life of a gun is centered (whether the external portions consist of rings or of coiled wire) is obviously of vastly graver consequence, as affecting the stability of the gun, than the possible effect of a similar condition of things upon the efficiency of particular projectiles, and the importance of guarding against such a source of instability in the individual masses of which a gun is built up cannot be exaggerated. Since steel was first adopted as the material for the inner tubes or chases of our guns, some few casualties have occurred which careful investigation has shown it to be scarcely possible to ascribe to any other cause than the existence in the steel of severe internal stresses, which determined the rupture of the metal when it was subjected to the conflicting strains developed by the action of even very moderate powder pressures. The condition in which the steel might have been, in such instances, when subjected to the action of the exploding powder charge, may be illustrated by reference to the behavior some years ago of the tube of a large gun, in which, after the third proof round was fired, a circumferential crack was found to have become developed in the front threads of the breech screw. Upon removing the jacket from the tube, the crack extended forward along the chamber and into the rifling, and when the tube was placed in the lathe with a view of cutting off the injured portion, the crack suddenly developed itself with a loud report, and ran along to within 8 feet of the muzzle; a spiral crack at the same time ran completely round the tube, which fell in two upon removal from the lathe. The system introduced some years since of tempering, or oil-hardening as it is termed, the several parts of a steel gun, for the purpose of increasing the tenacity of the material, by raising the mass to a high temperature, and then immersing it in oil, has been demonstrated to result in the development of more or less severe internal stresses in the mass, which can only be removed by subsequent careful annealing; and until this latter practice was largely adopted, instances occurred from time to time at Woolwich, and at other gunmaking establishments, of the fracture of tubes and hoops of guns, either during their treatment in the workshop, or when at rest, or when, in the built-up condition, they have been for the first time exposed to the shock produced by the firing of the gun. One effect which the oil-hardening treatment has occasionally exercised in the case of particular qualities of steel is that of developing minute fissures or cracks in the metal, either superficially or in the interior of the mass. This cannot, of course, be rectified by any annealing process, and it is still a question, to be determined by the teachings of experience and the results of investigations, whether any definite or reliable modifications in the composition of steel used for guns, tending to secure the desired combination of hardness and tenacity, may not be introduced, with the result that a method of treatment of the metal may be discarded which, however carefully applied, and however efficient the means adopted for reducing or neutralizing its possible prejudical influence upon the physical stability of the parts of which a gun is built up, carries with it inherent elements of uncertainty and possible danger.—*Sir Frederick Abel.*

A DEVICE TO HOLD BAGS OPEN FOR FILLING.

The bag holder shown in the illustration consists of a frame mounted to revolve, and provided with a number of holders of novel construction, whereby a number of bags may be held in open position for conveniently filling them. It has been patented by Mr. James Davnie, of Hallock, Minn. One of the views shows four bags held open by the holder, another view representing one of the holders in more detail, while the small figure is a side view of the spring-pressed arm of a holder. The bottom of the frame is mounted to turn on a base, in the top of which are rollers arranged in a circle, there being a track on the under side of the bottom of the frame, in the center of which is a pivot pin. In the middle of the frame is a post, from the upper end of which extend a number of horizontal arms, each resting on a separate post at its outer end. Between these horizontal arms are the spaces in which the bags are supported in open position by means of holders on top of the arms. Each holder has a fixed segmental arm and a movable segmental arm, both arms being set edgewise, and each having on its top an outwardly extending flange, over which is passed the edges of the open end of the bag, whereby the latter is supported on the arms. The movable arm of each holder is pivoted at its inner end on the horizontal arm, and its outer end is formed into a handle which slides on a segmental section supported on each of the outer parts. From the handle of each movable holder arm two segmental rods extend outwardly, one rod carrying a coiled spring arranged to draw the arm to its outermost position, or away from the fixed arm, by means of the tension of the spring. The other rod has a collar abutting against a bearing, to limit the movement of the swinging arm. In placing bags in position on the holder, the operator first passes the upper edges of the bag over the flange of the fixed arm, then moves toward it the swinging arm, and passes the other edges of the bag over the latter, the coiled spring then drawing the movable arm backward, holding open the mouth of the bag, and supporting it in position between the two arms. The frame is then revolved for the placing of other bags in position in a similar manner.



DAVNIE'S BAG HOLDER.

THE greatest known depth that oceans have been sounded is over 4,600 fathoms, in the Japan Sea.

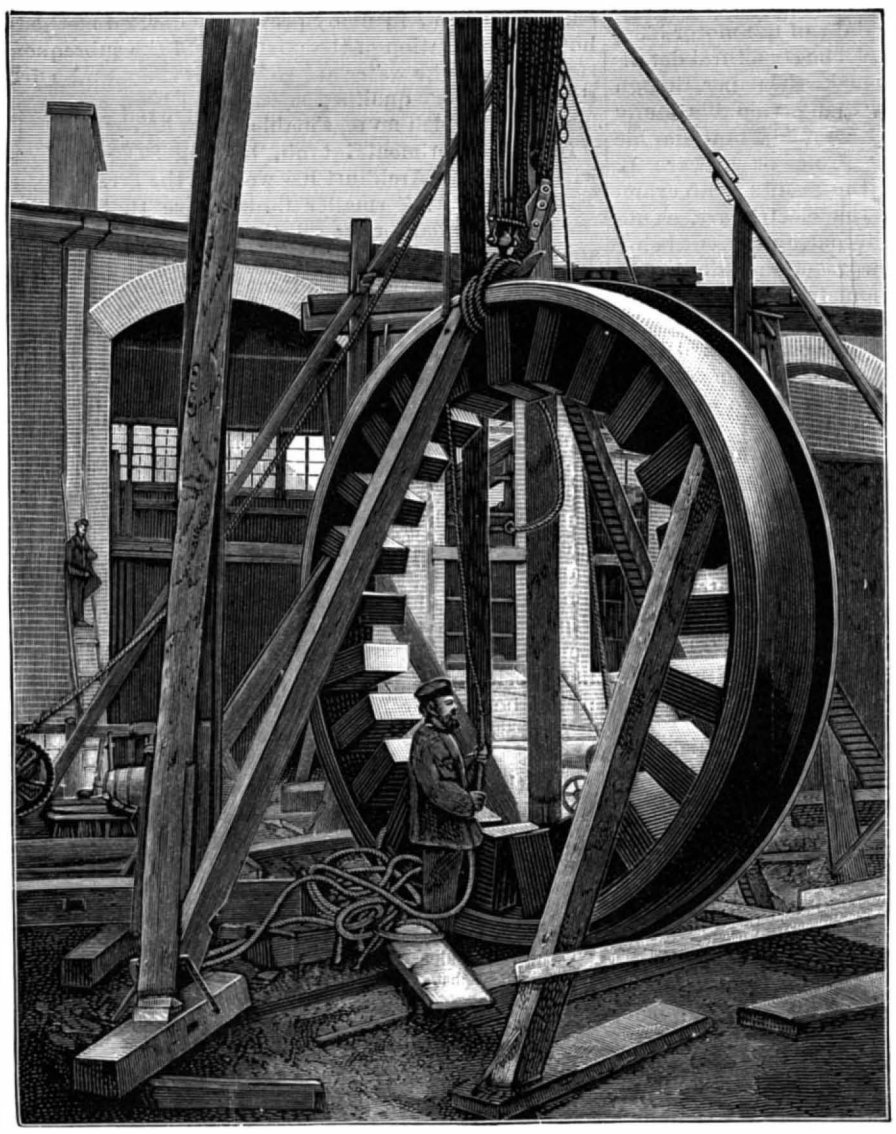
ALUMINUM WORKS IN SWITZERLAND.

The Aluminum Industry Company, limited, is the title of a company formed not long ago at Zurich, Switzerland, with a capital of $2,000,000, for the manufacture of the alloys and pure metal aluminum by the electric method. Cryolite is exposed to the electric current. Some idea of the extensive nature of the enterprise will be gained when we state that 4,000 horse power is available, to obtain which the company employs turbine wheels, taking water from the River Rhine, at a point just above the Rhine Falls, near Schaffhausen, actually Venhausen.

The dynamo machines were constructed by the Machine Works Company at Oerlikon. Up to the present time an altogether erroneous opinion has prevailed to the effect that colossal machines would be quickly ruined by continuous working. The regularity of the work at Venhausen, however, and the fact that machines there have been in use day and night already for over a year, without the least interruption occuring, demonstrate, says *Engineering*, the groundlessness of the fear. Machines constructed for only 6,000 amperes have been worked at Venhausen with 15,000 amperes without being in the least degree damaged. The new or additional plant of the Aluminum Industry Company comprises for the present three machines. Two large machines of 600 horse power each, which serve for the production of aluminum, and a smaller machine of 300 horse power for exciting the field magnets of the former, and other machines which may become necessary hereafter, as well as for lighting purposes and for driving sundry motors.

The field magnets of the large machines resemble an inwardly toothed wheel and consist of 24 poles. The whole magnet frame consists of a single piece, cast at the Oerlikon foundry, and weighs, without taking into consideration the copper wrapping, no less than 12,000 kilos. (12 tons), the outer diameter is 3·6 meters (11 feet 9 inches), the inner diameter which contains the armature is of 2·43 meters.

The armature is constructed of the so-called drum type, Mr. C. L. Brown's patent, and possesses the peculiarity that the wires do not rest outside on the armature iron, but are placed in openings close to the periphery of the latter. These wires are connected with the commutator by means of U-shaped strips of copper. On the back or upper part similar strips are used, but instead of being connected to the commutator they are fastened together in a very simple way.



FIELD MAGNET OF THE GREAT DYNAMO OF THE ALUMINUM INDUSTRY CO.

The arrangement described above allows any of the wires to be taken off easily in case of repairs without unfastening any metal joints, as each wire is kept separate from the others by the iron of the armature. The armature has 240 wires, which are in connection with a commutator, consisting of 120 segments. The diameter of the commutator is as much as 1·800 meters, a dimension necessitated by the enormous strength of the current, which much surpasses the power developed by the largest machines known up to the present time. The current is transferred through 24 points to sets of 5 brushes of 50 millimeters in width, of which 12 are alternately in connection with a massive copper ring, from which the current is supplied direct to the furnaces.

These rings were cast in Venhausen, two of them being required for each machine; they contain over 3,000 kilos. of copper. It was only possible to cast these rings perfectly solid by means of adding a little aluminum to the copper. An ingenious contrivance renders it possible not only to turn the double brush-holding rings round their axes, so as to place the brushes properly, but also to remove them as may be required; in addition to this each brush is provided with a simple apparatus for adjusting it as may be rendered necessary by wear.

Contrary to the general rule, the axes of these machines are not horizontal, but vertical, the armature being set over, and coupled directly with the turbines. A special advantage of this arrangement is, in the first place, the great facility for handling the commutators with 120 brushes for each machine. Another advantage is that the copper dust from the commutator and brushes falls directly underneath, and not into the magnet frame and armature, which would be the case with a horizontal position. Furthermore, the space required for the machine is very small in comparison with its power, and last, but not least, there is also a considerable saving of power, owing to the fact that, being directly coupled to the turbines, no transmission mechanism is necessary, the friction being reduced to a minimum by the relieving valves.

The two larger machines are constructed to develop 14,000 amperes at 30 volts, or 420,000 watts, with uninterrupted working day and night, but this estimate is rather low, as the power may be increased on special occasions to 500,000 watts.

The number of revolutions is 200 a minute, but 150 are sufficient to give the full current specified. These machines are the largest direct current dynamos in the world.

Visitors to the works generally show a certain amount of uneasiness when approaching these very powerful currents, but there is no ground for such uneasiness, for low tension currents do not involve any danger whatever.

Progress of Gunnery.

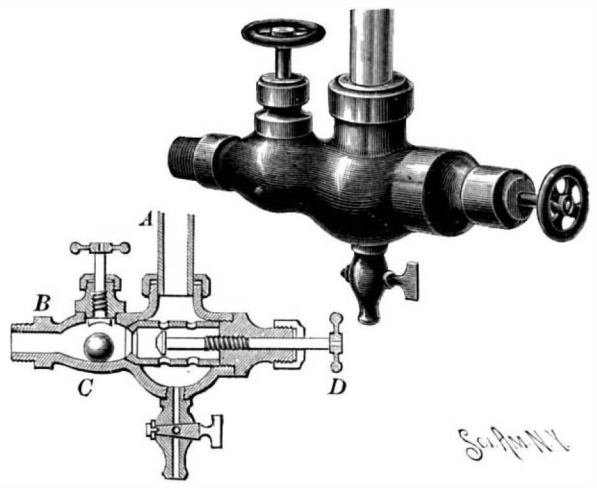
In former days our most powerful weapons were the 68 pounder or 8 inch 95 cwt. smooth bore gun, used with a charge of 18 lb. of powder, which threw a spherical cast iron shell of about 48 lb. weight, containing 2 lb. 9 oz. of powder; and the 13 inch cast iron sea service mortar, used for bombardment, for which the spherical shell weighed 207 lb., and the projecting charge was 20 lb. of powder. The positions which these pieces then held are now occupied by the 8 inch rifled howitzer, throwing a conoidal wrought iron or steel shell, charged with a much more powerful explosive than powder; the 12 inch breech-loading gun of 45 tons weight, with a charge of 295 lb. of powder, throwing a projectile of 682½ lb. weight; the 80 ton 16 inch muzzle-loading gun, with a charge of 450 lb. and a projectile weighing 1,640 lb.; and the 110 ton breech-loading gun of 16¼ inches caliber, which throws steel projectiles weighing 1,800 lb. with a powder charge of 960 lb. The cost of production of the smooth bore cast iron guns in those days ranged from $125 to $150 per ton; now, our rifled steel breech-loading guns cost from $850 to $1,000 per ton.

A Train Delayed by Caterpillars.

A dispatch from Mankato, Minn., May 23, says: "All the trains on the Milwaukee road this morning were delayed at a point seven miles out of this city by millions of caterpillars which had crawled upon the rails to sun themselves. Sand boxes were soon exhausted and two engines were hardly sufficient to move the train. The morning freight was an hour and ten minutes in going two miles. The caterpillars were ground into masses of grease over which the wheels slipped. The caterpillars have been a pest in that locality for two weeks."

AN IMPROVED WATER GAUGE.

A gauge designed to prevent the overflow of steam and water in case the glass breaks, while permitting of readily blowing off the gauge whenever desired, is shown in section and perspective by the engraving.



McFARLANE & BARRETT'S WATER GAUGE.

It has been patented by Mr. William A. McFarlane and Simeon A. Barrett, of San Bernardino, Cal. The two cocks of the gauge, of which only one is shown, are provided with the usual connecting glass, A, each cock having a casing, a hollow extension of which, B, screws into the boiler, establishing connection between the interior of the boiler, the casing, and the glass. In the hollow extension connecting with the boiler is an enlarged portion, C, in which is a ball adapted to be seated on the end of a valve plug screwing into the casing opposite the hollow extension. This valve plug extends across the casing, and has in its walls a series of openings and a second seat, adapted to be engaged by a valve held on a valve stem with a handle, D, this valve stem passing centrally through the plug. In the bottom of the casing is a pet cock, which, when opened, serves to blow off the gauge. To lock the ball in place in the enlarged portion, C, when it is desired to blow off the gauge, a curved clamping plate, adapted to fit on one side of the ball, is held on the lower end of a valve stem screwing in a suitable cap, and provided with a handle. With this gauge, in case the glass breaks, the water from the boiler forces the ball to the valve seat at the end of the valve plug, so that the water cannot escape into the casing and out through the broken glass. The operator can then turn the handle, D, to move the valve on the stem connected therewith to its seat, preventing the escape of water until a new glass has been placed in position. When it is desired to blow off the gauge, the clamping plate is moved by its valve stem to lock the ball in place in the enlargement, C, and, the valve of the pet cock being opened, the water freely passes through the casing and out of the cock. The several parts are so arranged that the ball and the valve plug may be readily taken out, in order to clean the gauge, without disturbing the position of the two parts and the glass.

New Torpedo Protections.

The Nile battle ship lately proceeded to the back of the Isle of Wight, for the trial of a new system of torpedo defenses, the invention of Captain Wilson, of the Vernon. The Nile is the first vessel in which hollow steel booms have been substituted for the ordinary cumbrous wooden spars. The new booms are of the usual length, between 30 feet and 40 feet, which is understood to be the limit of safety, and arranged diagonally at equal distances along the sides. The topping lifts are also disposed obliquely, but in the opposite direction to the set of the booms, so that when they are let go the booms, in falling into position at right angles with the ship, carry the ring nets into the water, and when raised they pull up the nets and the way of the ship is not impeded. Another feature of the system is that the usual hook attachments are dispensed with, the heel of the boom being stepped against the skin of the vessel, where it is held by a chain and fore and aft guys, and kept from slipping by a shallow socket resembling in form the letter L reversed. The trial, which was watched by the assistant controller of the navy, the members of the torpedo committee, and the officers passing through the torpedo class, was considered satisfactory, the whole ship being dressed in her crinoline defense in a couple of minutes. This alertness in preparing for torpedo attack is the special merit of the new system, since it is of comparative unimportance how long it takes to stow the defense. It is, however, doubtful whether, considering their slender connection with the side, the booms would retain their position in a heavy seaway, or be able to resist the shock of a torpedo hung up in the nets.—*London Times.*

PHOTOGRAPHIC NOTES.

Retouching Enlarged Negatives.—The following method of retouching enlarged negatives is practiced by a well-known photographic firm of Berlin. *Papier vegetal* is used for the purpose on account of its fineness and transparency. Two pieces of this paper of the size of the negative are cut out, one of them being mounted on the film side, the other one on the glass side of the negative. For mounting, the paper is at first slightly wetted, so that it will become quite tight after drying on the negative, when it is coated all round with glue, and transferred to the glass. In retouching, the larger portions of the negative which are too transparent are strengthened on the paper pasted on the glass side of the negative with powdered black chalk or plumbago, by means of a leather or paper stomp. On the paper mounted on the film side of the negative, the flesh portions are equalized with the brush and Indian ink, bold effects of light being at the same time put in where it seems necessary. It is not at all necessary to work very accurately, since the light produces a softness of effect which could only be equaled by the most laborious retouching of the ordinary kind. The enlarged negative is then printed in the usual manner in the printing frame.

Developers for Shortly Exposed Plates.—Mr. Victor Angerer, one of the most eminent photographers of Vienna, has made a series of experiments with different developers in order to determine which of them acts most energetically in the case of instantaneous exposures. For this purpose he used: (1) The iron developer with the well known accelerator; (2) the cristallos developer; (3) hydroquinone developer with ferrocyanide of potassium, according to the formula of Mr. Lainer; (4) the combined hydroquinone and eikonogen developer. The solutions were freshly prepared—except the cristallos developer—and the plates developed at the same time. The results were the following: Developer No. 1 gave the fewest details, and a slightly fogged negative; No. 2, plenty of details, but the lights too dense, no fog; No. 3, plenty of details, very dense lights, and a slightly fogged negative; No. 4, an entirely clear and soft negative with very fine details and with all the half tones. The combined hydroquinone and eikonogen developer (No. 4), which was superior to all others, was prepared according to the following formula:

Solution No. 1.

Distilled water	1,250 c. c.
Potassium sulphite	150 grammes.
Eikonogen	22½ "
Hydroquinone	7½ "

Solution No. 2.

Water	250 c. c.
Potassium carbonate	75 grammes.

For use, five parts of solution No. 1 were mixed with one part of solution No. 2.

To Produce Ground Glass.—The following process to produce ground glass has been recommended to me by a professional photographer. A cup is filled up to one-half with water, to which some emery powder is added. Stir well, allow to stand for about five minutes, and decant into another cup. Allow to stand again for five minutes, and decant the fluid into a third cup. In each of the cups remains a sediment of emery powder of various degrees of granularity. Take a well cleaned glass plate, and commence to grind it with the coarsest grain; proceed with the grain of the second cup, and finish with the finest one. A semi-transparent glass plate of exceeding fineness is obtained by this method. —*H. E. Gunther, in Photo. News.*

Platinum Toning Bath for Silver Prints.—M. Brunel Paul recommends the following for a platinum toning bath, which he says is stable and keeps for a length of time:

Chloroplatinite of soda	2 parts.
Chloride of sodium	2 "
Bitartrate of soda	1 part.

Dissolve in 1,000 parts of cold water. The bitartrate has the effect of rendering the bath slightly acid, which is necessary for effecting the toning. This bath keeps good for a long time, and gives a very fine effect. The prints first washed in water may be immersed in it directly. The first tones are purple, purple-brown, and finally of the black of Indian ink. After toning, the print is passed through a bath of hyposulphite of soda twenty per cent, and thoroughly washed. The tones are absolutely unalterable and particularly suited to landscapes.

Sketching on Lantern Slides.—M. Canfyn, of the Association Belge, recommends a method of preparing lantern slides for drawing on with pencil. This glass is first coated with a "matt" varnish of the following composition:

Ether	100 parts.
Sandarac	2 "
Mastic	2 "
Benzine	20 "

After the drawing has been made upon the surface so prepared it is covered with the following varnish:

Ether	100 parts.
Sandarac	3 "
Mastic	3 "

This varnish dries brilliantly smooth, so that the slide appears perfectly transparent, and may be used well for lantern projections.—*Br. Jour. of Photo.*

The Incandescent Lamp Suit.

A suit brought upon one of Edison's fundamental incandescent lamp patents, No. 223,898, of January 27, 1880, is now upon its final hearing in the United States Circuit Court in this city before Judge Wallace. It is one of the most important patent suits that has recently come to trial, and if awarded in favor of the Edison patent, will give the Edison companies the monopoly of incandescent lamp manufacture for some six years to come, besides the benefits of an accounting for past infringements. The parties to the suit are the Edison Electric Light Company against the United States Electric Lighting Company.

The interest involved is enormous; it is estimated that from fifty thousand to seventy-five thousand lamps are manufactured daily, the royalty or profit on which would represent several millions of dollars annually. The counsel include Clarence A. Seward, Grosvenor P. Lowrey and Richard N. Dyer for the Edison Co., and Edmund Netmore, Gen. Duncan, and Frederick H. Betts for the defendants. In the opening argument Mr. Dyer laid much stress on the commercial success of the Edison lamp, claiming that up to his time the critical point for the construction of a successful lamp had been missed by all inventors.

The American Institute of Electrical Engineers.

The eighth annual meeting of the American Institute of Electrical Engineers, held on May 19, 20 and 21, in this city, in many respects may be noted as the most important of these gatherings. The rapid development of the science, the clearing up of old difficulties and the development of new problems have operated to evolve papers of high merit and indicative of much research and systematization.

For the succeeding year Professor Alexander Graham Bell was elected president, succeeding Professor William A. Anthony. Professor Anthony presided over the sessions of the meeting.

The first paper read was one by Francis B. Crocker, on "The Perfection of Stationary Electric Motors." This was largely devoted to an elucidation of the system of construction and of the data of the motor identified with the lecturer's name. The structural details were so clearly presented as to make the paper, though apparently of limited scope, a really valuable study for dynamo builders. A paper on "A Photographic Study of the Electric Arc," by Professor Edward L. Nichols, followed. This gave the results of an examination of the fluctuations in the electric arc, as observed by photography, the alternating current being employed. A species of flame reactions, similar to those obtained with the manometric capsule or by other methods in the well known physical experiments with gas flames, were discovered. The sensitized plate during exposure was driven at high speed across the field of projection. This operated to give a band-like photograph, whose irregularities disclosed the alternations and cessations of the arc due to the reversals of current. The photographs strongly suggest the revolving mirror reflections of a sensitive flame affected by a sound.

The subject of electric welding, as treated by Frederick A. C. Perrine, D.Sc., was of much interest as bringing the description of the commercial uses of the process up to date. The daily record at the Roebling wire mills shows nearly 1,000 welds of wire, in great part for telegraph and submarine cable work. The Trenton Iron Company use the process for uniting iron rope. The process results in a two inch weld, at which the rope is converted into a solid bar. The welding is done with the ends of the rope abutting within a cast iron collar, which collar is afterward broken off. Another works uses the process for welding car wheel tires, which are 4 inches wide and ¾ inch thick, as well as light wagon wheel tires. One of the Johnstown, Pa., works welds rails together—about the heaviest line of work yet executed. Band saws not only have their ends thus united, but broken teeth are replaced by electric welding, a drop of oil being applied to the replaced tooth to give it proper temper. The welding of chains and shells for heavy ordnance was also spoken of. The limitations of the process and its disadvantages as far as they exist were treated of in the conclusion of the paper.

Prof. George S. Moler's paper upon "An Alternating Current Potentiometer" was an excellent contribution to the practical measurement of alternating current voltage. A lamp was lighted by alternating and constant current in rapid succession, the change from one to the other being effected by a switch. The constant current, being of known factors, was the standard. The regulation was so effected that both currents gave equal intensity of illumination, so that the reading of the constant circuit voltmeter gave the voltage of the other circuit. It was proposed to use the apparatus for standardizing voltmeters.

Carl Hering's paper upon "A New Graphical Method of Calculating Leads for Wiring" was doubly acceptable, as it indicates a system of three-data calculation upon a single sheet—something which would seem to be of wide applicability in many calculations, as in gas photometry and other work.

Other papers were read which cannot be summarized here. On the evening of May 20, Mr. Nikola Tesla gave a most brilliant lecture and series of demonstrations entitled "Experiments with Alternating Currents of High Potential." His experiments were performed with a current of immense rapidity of alternation, 20,000 periods per second, and one which included a difference of potential which ran up as high sometimes as 250,000 volts. Geissler tubes and incandescent lamps were lighted without any direct contact. The lecture lasted nearly two and one-half hours. Some of the results suggested the possibility of lighting the room without any direct contact by simple distribution of Geissler tubes and lamps in the excited field. This the lecturer stated he would have done had time permitted him to make the necessary preparations. The currents or discharges produced at the lecture would pass through ordinary insulators, such as glass, India rubber and paper, with heat effects, sometimes producing a species of welding.

A reception by the Electric Club, visits to electric works, and an exhibition of historic books and apparatus were features of the meeting, which adjourned to meet a year hence.

New Process of Water Softening.

A new process of softening locomotive feed water has been devised by Mr. Leonard Archbutt and Mr. Deeley, and, after much experiment at the Midland Railway Company's works at Derby, is about to be extensively adopted at that place. The details of the plant and process were communicated by these two gentlemen in a paper read on May 4 before the London section of the Society of Chemical Industry, and from its favorable reception there, much success may be safely foretold for the method they have adopted.

It consists, says *The Engineer*, in treating the water to be softened with a mixture of lime, sodium carbonate, and aluminum sulphate, under somewhat peculiar conditions. The chemicals used are in no way novel, having been employed in the Maignen process for softening water and in many previously devised methods, but the application of the mixture and the subsequent treatment of the water are so well devised and effective, that a very qualified success has been converted into one of which no reasonable doubt can exist.

In the experimental tank, holding 20,000 gallons, with which Mr. Archbutt has worked, the arrangement was as follows: A smaller tank, above that holding the water, served for the solution of the chemicals, the aqueous solution formed therein being allowed to flow into a well in the larger tank, at the bottom of which is a steam trajector, which forcibly mixes the concentrated solution of purifying reagents with the water to be treated. The sludge from a previous operation is allowed to remain at the bottom of the large tank during this part of the process, and so far from any efforts being made to prevent its admixture with the fresh supply of water, is forcibly intermingled therewith by air being forced in, with the view of rousing it thoroughly after the admixture of the chemicals proper. The reason for this is simply that it is found that the coarse-grained precipitate formed in a previous operation materially aids the deposition of the finely divided suspended matter that results from the action of the chemical reagents. So completely does this occur, that subsidence is very rapid and clear. Purified effluent can be drawn off without recourse being needed to filter presses or settling plates to expedite it in any way.

That the process is effective is clearly shown by the following analyses:

	Before treatment. Grains per gal.	After treatment. Grains per gal.
Calcium carbonate	9·74	2·25
Magnesium carbonate	2·45	2·18
Sodium carbonate	—	0·85
Calcium sulphate	5·64	—
Magnesium sulphate	1·34	—
Sodium sulphate	3·41	11·33
Sodium chloride	2·81	3·38
Silica	0·34	0·48
Total	25·74	20·47
Lime	7·78	1·26
Magnesia	1·62	1·02

It was found, however, that water thus purified coated the feeding apparatus of the boilers in which it was used, the cause being the deposition of a further quantity of calcium and magnesium salts on raising the temperature of the water. This trouble, which threatened to be formidable, was completely obviated by slightly carbonating the water after its purification by leading into it the gases from a coke fire, after which treatment no difficulty of the kind presented itself. With this modification the method promises to be a complete success, and we learn that the Midland Railway Company contemplates putting down plant for the purification of the whole of the water used for locomotive purposes at the central works at Derby.

GREAT TOWER OF THE CITY HALL, PHILADELPHIA—TOTAL HEIGHT, 547 FEET.

No one has visited Philadelphia without being struck by the splendid pile that we illustrate on our front page. For many years its walls have been gradually rising, and although the main portions have been finished and occupied for some time, the tower, which is intended to crown the whole work, has but slowly reached up into the sky. The marble work is now finished, and it only remains to put up the iron upper work, when the whole will be completed. The tower, although unfinished, is already 350 feet high, and is shown in its present state in one of the views. The total height, when completed, will be 547 feet 2½ inches, and will only be surpassed in this respect by the Eiffel tower and the Washington monument, which surpasses it by less than three feet. Without including the court, the building covers 4½ acres, and has a frontage on one side of 470 feet and on the other of 486½ feet.

John Ord, architect of the city of Philadelphia, who is now in charge of the work inaugurated and carried almost to completion by his predecessor, the late John McArthur, Jr., said: We are now engaged with the construction of the iron superstructure or tower which is to crown the stone work now in position and make the new City Hall of Philadelphia when completed the highest building in the world, with the exception of the Washington monument. In all the work carried on at anything like such an elevation as this, the greatest precaution must be taken to prevent stray nails, blocks of wood and workmen's tools from falling through such a great distance, and to insure against this it is necessary to rig an enormous circular platform, consisting of a hub with huge yellow pine outriggers. This platform will weigh 150 tons when placed in position, and in shape will resemble a huge cart wheel. The center of the platform, or what I have called the hub, is fastened to the eleventh story of the tower or the top of the stone work, while the spokes stretch out 55 feet horizontally, extending about 20 feet beyond the outer walls of the tower. These spokes are 15 inches × 18 inches in diameter, and are united by a wrought iron fish plate. The outriggers are twenty-four in number, weighing in all 168,000 pounds. Joists 3 × 14 inches fastened to the outriggers will support an oak plank floor four inches thick.

The platform is encircled by a heavy railing, and will be the base of operations for the erection of the most elaborate metal tower in existence. The clock story of the tower, 67 feet in height, will be supported by 16 cast iron columns, each 35 feet long and weighing 15,000 pounds. The supports for this enormous weight will be furnished by a wrought iron skeleton structure consisting of eight composite columns resting on four box girders, which are set in position on top of the present granite bond stones, with cast iron bed plates to secure a solid bearing throughout the structure. These girders will afford a support for eight vertical columns, standing 67 feet 8 inches above the stone work and converging at this distance to a center, in order to furnish a support for the Penn statue.

The columns are made in pieces of varying length, and are to be erected in several stages in height. Each of these stages is to be composed of eight posts firmly secured and braced horizontally and diagonally and made absolutely secure before the next succeeding stage is erected. At the level of 67 feet 8 inches above the marble work a floor will be constructed of 9 inch rolled I beams weighing 70 pounds per yard, resting on eight cantilever trusses. These trusses will be secured to and spring from each of the main posts, and are to abut upon and be keyed up to a ring of wrought iron 3 feet deep and 13 inches clear internal diameter, forming an open 'well' in the center of the floor. Another floor will be constructed on the top of the eleventh stage of seven 55 lb. I beams, which will be covered with cast iron plates bolted to them. This floor will give access to a small gallery or balcony, which will be supported on strongly framed wrought iron brackets and protected with heavy railing made of gas pipe rails and bolts, thoroughly bolted to cast iron work. A supplementary frame will be constructed outside of this frame, to give support to the outside cast iron shell. Aluminum will probably be the metal used in the external covering of the dome, and in the construction of the ornamental groups. The clock story is now in course of erection at Tacony, where it is to be erected in its entirety. It will then be taken apart, the segments being carefully numbered and taken to Philadelphia, where they will be put together permanently. The top of the clock story will, however, be kept at Tacony to serve as a base for building the next story. An important factor to be considered in the erection of the tower is the elements. Great precautions must be taken against damage by cyclones and heavy gales at such a high altitude. With this end in view calculations have been made, and it is estimated that each square foot of the tower will resist a wind force of fifty pounds. The statue of Penn, which is to surmount the tower, is now about completed, and is said to be the largest iron casting in the world. Penn will be taken to this city in 47 pieces, and will measure 36 feet from the soles of his feet to the crown of his hat.

Some idea of the enormous size of this figure may be gleaned from some of the measurements of his person. The enormous height of the tower is shown by the fact that the statue dwindles into a pygmy when mounted on the apex of the tower. The head is 4 feet in diameter and 7 feet long with the hat on. The nose is 15 inches long, and the distance between the eyes 16 inches. The eyes are 9 inches long, and the mouth is 12 inches across. Penn's hat is 12 feet in circumference. It is 4 feet high, and the rim is 8 feet in diameter. It has been estimated that he wears a No. 52 hat. The calf of the leg is 9 feet around, and the upper leg measures 15 feet. The foot is nearly 6 feet long. His finger nails are 5 inches long, and the middle finger is 2 feet 6 inches long.

The four large ornamental figures are also of cast iron structurally. They are a hunter, an Indian with a boy, a Swede, an Indian with a dog. Each of these figures will be cut into 18 pieces before being taken to this city. One will be placed over each corner of the clock tower, between them being the four American eagles. Eight lunette windows will furnish light and ventilation to the upper part of the dome. In the construction of the tower at Tacony the greatest efforts were made to secure competent and skilled artisans and to provide all the facilities required for turning out the best work. And it is believed that this has been accomplished. The pins which are to fasten the iron pieces together are of hardened steel 2½ inches in diameter and 16 inches in length. The plaster models from which the clock story and the statue have been fashioned were all made at this office. A delicate piece of work will be the placing in position of the statue. The pieces of which it is composed will be carried from the base of the tower to the scaffold by the tower elevator. Here by steam power they will be elevated piece by piece and placed in permanent position, beginning with the feet and building upward. Special hoisting machines will be employed to elevate the heavier pieces of the iron superstructure. Each separate piece of cast iron work, and also the fastenings, after being fitted, will be heated to a temperature of 300° F. and immersed in a bath of pure linseed oil. Another interesting piece of work will be the counterpoising of the statue. This will be done by means of a mass of metal 5 feet long and 2 feet in diameter, firmly keyed into a flanged shaft, which in turn is keyed into the cast iron cap-piece of the statue. Great care will be observed in constructing the machinery that will be used in elevating the statue of Penn and placing it in position. This apparatus will consist of eight huge timber posts securely fixed below the base of the statue. To these posts stout tackle will be attached, and steel cables will be employed to hold the different parts of the statue in position while awaiting permanent position.

Guns and Projectiles.

Bids were recently opened in the Ordnance Bureau of the War Department for supplying steel forgings for eight, ten, and twelve inch guns for coast defense, and for armor-piercing projectiles for guns of these calibers. The Midvale Steel Company bid for ten sets of eight inch forgings, 29 cents per pound; for ten sets of ten inch forgings, 27 cents per pound; for ten sets of twelve inch forgings, 27 cents per pound.

The Bethlehem Iron Works Company, of South Bethlehem, Penn., offered to supply all the forgings at 28¼ cents per pound, or any portion of them at 30 cents per pound. As an alternative bid, the Bethlehem Company offered to supply eleven sets of eight inch forgings, ten sets of ten inch, and eleven sets of twelve inch at $800,000. This bid, however, was for lower weight forgings than are called for, and will not be considered.

There were two bids for the armor-piercing shells, for which the department asked for offers to the amount of $100,000. The Carpenter Steel Company, of Reading, Penn., which is now making projectiles for the navy, offered to supply 104 eight inch projectiles at $15,288 or $147 each, 208 ten inch projectiles at $57,408 or $276 each, and 52 twelve inch projectiles at $24,960 or $480 each.

The Midvale Steel Company offered to supply 100 eight inch projectiles at $14,500, 205 ten inch projectiles at $58,425, and 50 twelve inch projectiles at $25,000.

The contract for the gun forgings will be awarded to the Midvale Company and that for the projectiles to the Carpenter Steel Company.

To obtain printing rollers without a seam, the engraved or relievo plates produced in the ordinary way are bent together, so as to form a cylinder with the design upon its outer surface, which serves to produce in the galvanic way an outer cylindrical mould with the design on its inner side; which mould being separated from the cylinder and strengthened by wrapping a heated sheet of gutta percha around it, is then used to produce in the galvanic way another hollow cylinder which carries the design upon its outer surface and is then mounted upon a solid metal core.

Correspondence.

Locomotives.

To the Editor of the Scientific American:

In your interesting article on the recent shipment of American locomotives to Australia you say: "A good illustration of the inadequacy of English locomotive designing to fulfill conditions of service on other than English roads was recently had on the Pennsylvania road, where an English locomotive built especially to compete with American locomotives was found unable to draw the regular trains," etc.

The above locomotive is on the compound principle, and the compound locomotive is on its trial. In the interests of truth and experiment, will you please insert the following testimony of two of your contemporaries in this country?

In its issue of April 24, 1891, the English *Engineer* says: "The Webb compound locomotive which was sent out to the States is in express service between New York and Philadelphia again, and, the *Locomotive Engineer* (American) says, doing remarkably good work. She made the ninety miles the other day in two hours and four minutes, hauling eight heavy coaches, and making seven stops. We recently saw a letter from a prominent Pennsylvania official in which he said: 'I am not at liberty to give exact figures as to the saving of coal shown by the Webb engine over our regular passenger locomotives, but I will say that it has been considerably over 25 per cent.'"

Again, in its issue of February 20, 1891, the English *Engineering* says: "Replying to a correspondent, the *American Journal of Railway Appliances* gives some particulars of the performance of the Webb compound locomotive on the Pennsylvania Railroad. It states that for some months it took the 8:20 A. M. train from Philadelphia to New York and returned in the afternoon. The train consisted often of eight cars, which it took over the road in two hours, burning from 2,000 to 3,000 pounds of coal less than used by the standard Pennsylvania Railroad engines. It also ran from Jersey City to Long Branch on the 'Brokers' Express,' hauling six cars, which was timed to leave Jersey City the same time as the 'Congressional Express' for Washington, which had five cars and was pulled by one of the latest Pennsylvania engines, weighing much more than the Webb, and having cylinders of 19 inches diameter by 24 inches stroke. The two trains ran on the same track as far as Rahway, the compound leading, the other following; and during the whole time the standard engine was not once stopped by signal on account of closing upon the leading train."

Here, Mr. Editor, we have a competition on a "fair field with no favor;" and in justice to your readers you will, I trust, give them an opportunity to judge for themselves of the facts. J. BERNARD WALKER.

Corvallis, Oregon, May 14, 1891.

Bananas as Food and Medicine.

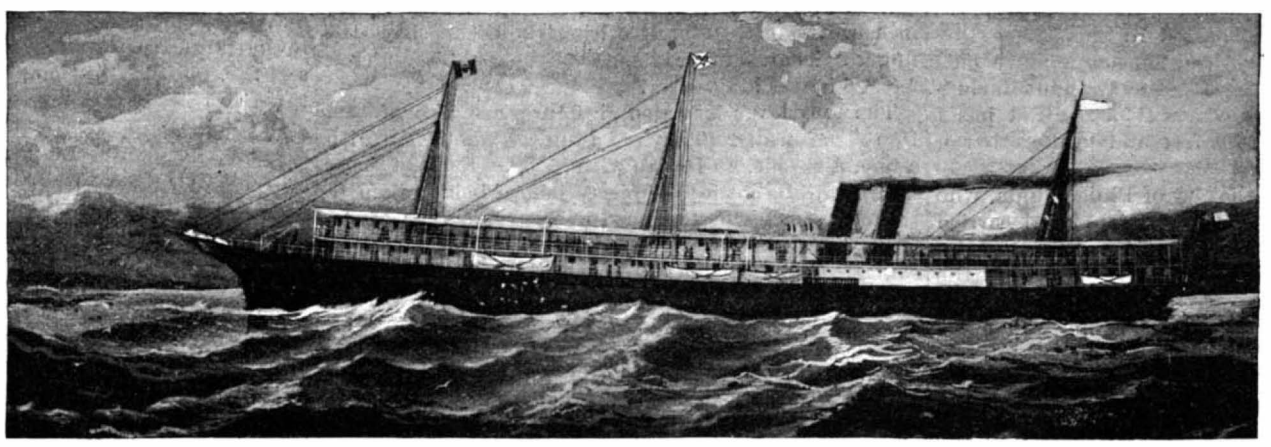
Dr. John Dougall, of St. Mungo's College, Glasgow, has a letter in a recent issue of the *Glasgow Herald* on the banana. He quotes from Stanley's "In Darkest Africa," showing that "for infants, persons of delicate digestion, dyspeptics, and those suffering from temporary derangements of the stomach, the flour, properly prepared, would be of universal demand." During Stanley's two attacks of gastritis a slight gruel of this flour, mixed with milk, was the only material that could be digested. It is odd, also, as pointed out in Stanley's book, that in most banana lands—Cuba, Brazil, West Indies—the valuable properties of the banana as an easily digested and nourishing food have been much overlooked. Dr. Dougall has made some experiments in making banana flour. He concludes that it should be made from the ripe fruit at its place of production. In trying to make it from bananas purchased in Glasgow, he obtained on drying the pulp a tough sweet mass like toasted figs, an appearance probably due to the conversion of starch into sugar. Bananas contain only about 50 per cent of pulp, and of this about 75 per cent is water. They would yield, therefore, only one-eighth part of flour.

Sanitary Science.

Sanitary science, says the *Sanitary News*, is a science that does not relate to the earth we live on or to the heavens we live under, but to the conditions of the homes we live in. We can live on the earth or under the heavens without knowing much about them, but to live best in our homes we must know them well. Geology cannot change the conditions of the earth beneath us, or astronomy those of the heavens above us, but sanitary science can change from unhealthy to healthy the conditions of the homes we live in. Is it not then a science worthy of study? It touches the highest interests of mankind, cleanses and purifies the present generation, and will strengthen and will glorify posterity. The effects of obedience to its laws are not remote but immediate. They touch the everyday life of all, and enter into all the relations of life. They give strength and vigor to whatever capacity in which human endeavor is put forth.

THE U. S. WARSHIP CHARLESTON PURSUES A CHILEAN REBEL SHIP.

The policy of the United States is to remain strictly neutral with relation to the affairs and quarrels of other nations. But the civil war now going on in Chile has given rise to an incident which renders necessary an indirect interference with one of the belligerents. We allude to the affair of the Itata, one of the vessels of the rebel party of Chile. This armed ship came into the harbor of San Diego, Cal., and, in defiance of law, took on board supplies and munitions of war. She was immediately seized by the authorities and taken possession of by the United States marshal. Unfortunately, our government had no vessel of war present and no adequate means of forcibly asserting its authority. So the Itata raised anchor and steamed off, carrying with her the representative of the government. This was on May 6.



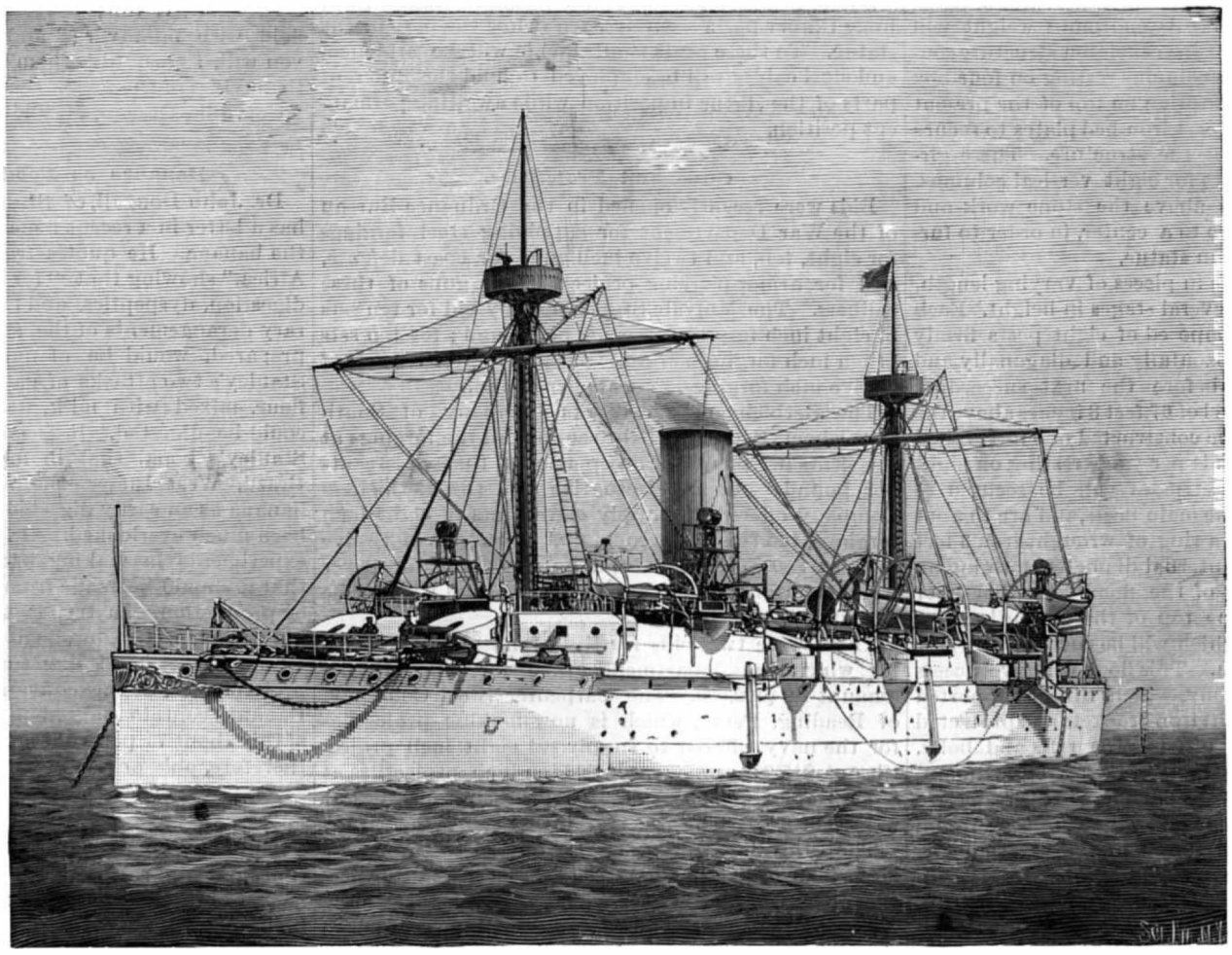
THE CHILEAN INSURGENT TRANSPORT STEAMER ITATA.

The President immediately ordered the recapture of the Itata. The war-ship Charleston was promptly dispatched from San Francisco in pursuit; it is understood her commander has orders to take or sink the vessel wherever found, outside the jurisdiction of a friendly nation. It is quite possible the rebels may resist the capture, and bring on a battle between some of their own ships and those of the United States. News of the result of the Charleston's mission is soon expected. At last accounts she had reached Callao, in Peru, on her way to Chile.

The Itata is an iron screw propeller of 1,200 tons and was built in England in 1873. She has compound engines, but is said to be incapable of steaming more than nine or ten knots an hour. We are indebted to the *Illustrated American* for our picture of the vessel.

The United States cruiser Charleston, which was sent in pursuit of the Itata, was built by the Union Iron Works of San Francisco. She is 300 feet long, of 45 feet beam, with a mean draught of 18½ feet, and has a displacement of 3,730 tons. Her contract called for 7,000 horse power from her compound engines, driving twin screws, but the average reached on her trial was only 6,666, although her speed was greater than had been expected, exceeding 18 knots an hour for four hours, and reaching as high as 19 knots.

The battery of the Charleston consists of two 8 inch and six 6 inch breech-loading rifles, with a secondary battery of rapid-fire guns, besides two revolving cannon on each mast, short Gatlings. The 8 inch gun propels a 250 pound projectile with a 125 pound charge of powder, while a 10 inch gun of the same pattern propels a 500 pound projectile with 250 pounds of powder.



THE U. S. CRUISER CHARLESTON.

The Cause of Influenza.

The annual meeting of the Michigan State Board of Health was held at the capitol, April 14, 1891. Professor Fall, Drs. Avery, Hazlewood, Vaughan, and Baker were present. Dr. Avery was re-elected president. Dr. Baker reported that he had worked out the cause of influenza. He said its greatly increased prevalence during the last three months is alarming, because so many other diseases follow that disease, and increase after it increases, the diseases which so increase being consumption, pneumonia, cerebro-spinal meningitis, rheumatism, osteomyelitis, etc., influenza seeming to bring in its train all of these most important diseases. Dr. Baker explained the causation of influenza. He stated that the germs of influenza are generally at all times present, and the germs of pneumonia, tuberculosis, and of the other specific diseases are somewhat widely disseminated; but that there must be certain coincident meteorological conditions to irritate the throat and air passages sufficiently to let the germs gain an entrance to the body. These meteorological conditions in this instance were the excessive prevalence of north and northeast winds, and the excessive amount of ozone during the past three months.

The prevention of influenza, and of the coincident rise in the other more dangerous diseases, has not been possible, because of ignorance of the causes. Now the causes are known, and the study of the measures for the prevention can begin.—*Therapeutic Gazette.*

Electricity in Ships of War.

The extent to which electricity is employed in modern warships may be gathered from the following particulars of the electrical outfits of eight vessels recently built and armed by Messrs. Sir W. G. Armstrong, Mitchell & Co., Limited, at their Elswick shipyard. In each of the three 2,675 ton, 19·5 knot, colonial cruisers, Katoomba, Mildura, and Wallaroo, the electric light installation comprises 267 lamps of 16 C. P. and 37 of 50 C. P.; 262 small and 24 main switches; 240 small and 24 main cut-out fuses. Each vessel is fitted with two yardarm reflectors, containing 8 lamps of 50 C. P., and two semaphore signaling arrangements, consisting of a box fitted with a mirror reflector which throws the light from four 16 C. P. lamps on two movable arms of a semaphore. All the instruments, such as compasses, engine room telegraphs, steering wheels, electrical indicators, etc., are specially lighted. Each vessel has three search light projectors—two of which are movable—and a generating plant consisting of two combined sets of "Willans" engines and "Siemens" dynamos, running at 415 revolutions per minute, and giving 300 amperes and 80 volts.

With reference to the armament, the four torpedo tubes in each ship are fired electrically from a distance—a duplicate system of wiring being provided in case one wire should be damaged—and the eight 4·7 inch Q. F. guns are also fitted with two alternative methods of electrial firing. In four smaller, 739 ton, 21 knot, colonial warships, also recently completed by Messrs. Armstrong, viz., the Boomerang, Karakatta, Plassy, and Assaye, internal electric lighting has not been considered necessary, but each has been fitted with a "Tower" engine and a "Siemens" dynamo, giving 100 amperes and 80 volts, one search light projector, one yardarm reflector with eight 50 C. P. lamps and semaphore reflector, etc. Each has, moreover, five torpedo tubes, fired electrically from the conning tower, and two 4·7 inch quick-firing guns also fired by electricity.

In another recently completed cruiser of Elswick build, the 25 De Mayo—a vessel of 3,200 tons displacement, 13,500 I. H. P., and 22·47 knots speed—the electrical outfit consists of three steam turbine dynamos, manufactured by Messrs. C. A. Parsons & Co., each capable of giving 200 amperes of current at 80 volts, 190 lamps of 16 C. P., 12 lamps of 50 C. P., and two yardarm reflectors; three search light projectors, one of which is in the military top. The three torpedo tubes, two 21 cm. guns, and eight 4·7 inch quick-firing guns, are all fired electrically, while the sights are illuminated by minute incandescent lamps for night service. All these vessels are wired on the double wire system, with lead-cased cables, on the plan originally introduced at Elswick, and the whole of the work has been carried out by Messrs. Sir W. G. Armstsong, Mitchell & Company's electrical staff, under the able superintendence of Mr. L. Newitt, with Mr. A. A. Campbell Swinton as electrical adviser.—*Electrical Review.*

Age of the Glacial Period.

In discussing the cause of the glacial period, Mr. Warren Upham discards the astronomic theory, since it seems wholly untenable in view of the geologic evidences that not many thousands of years have passed since the departure of the ice sheets. The measurements of the gorge and falls of St. Anthony, the surveys of Niagara Falls, the rates of wave cutting along the sides of Lake Michigan, the rates of filling of kettle holes, and the rate of deposition in the Connecticut valley at Northampton, Mass., all indicate that the time since the glacial period cannot exceed 10,000 years. Mr. Upham cites evidence in proof of the theory that the cause of the glacial period was great uplifts of the glaciated areas, probably in conjunction with important changes in the course and volume of the warm ocean currents.—*Am. Geol.*

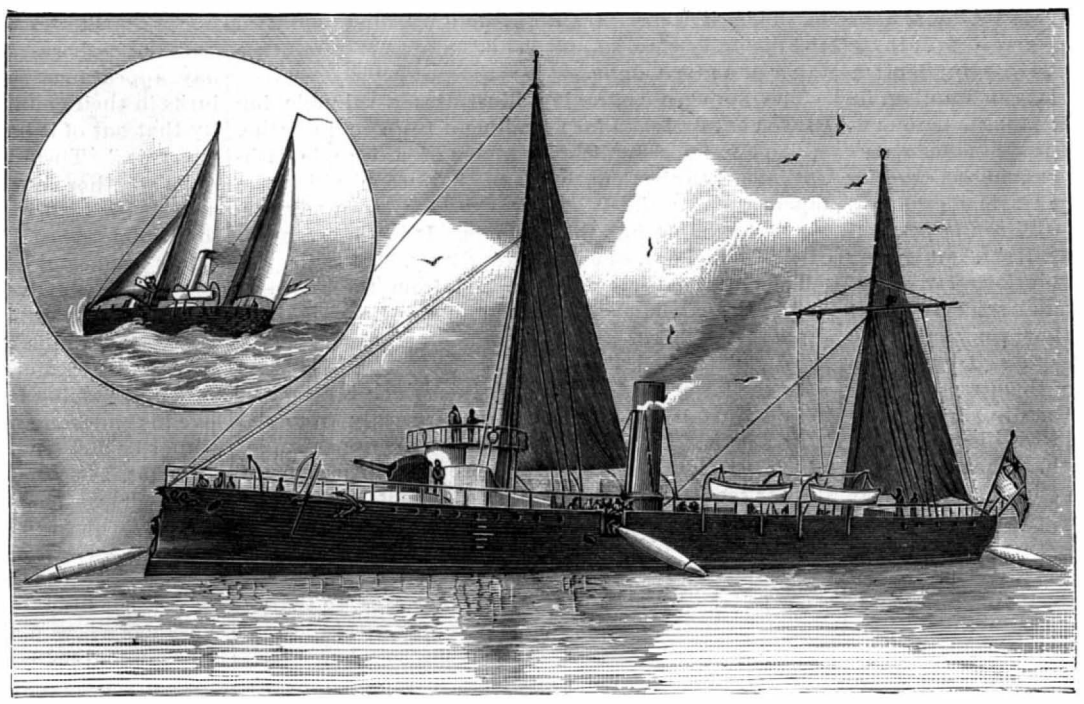
According to Census Bulletin No. 68, relating to manganese, prepared by Mr. Jos. D. Weeks, the production of manganese of the entire United States to be 23,927 long tons, with a total value of $238,939. This product is principally from the localities of Crimora (Virginia), Cartersville (Georgia), and Batesville (Arkansas), these districts having yielded 20,325 long tons. The ores are treated under three general classes, namely, manganese ores, manganiferous iron ores, and argentiferous manganese ores, and valuable information and statistics concerning each class are given.

Moulds for casting iron can only be made in sand. Iron or other metallic moulds chill the iron, and it does not fill well. The great heat at which iron melts will burn any other material, or will stick so as to break the mould.

REMARKABLE NAVAL COMBAT—A STEEL CRUISER SUNK BY TORPEDO BOATS.

Among the recent incidents of the civil war in Chile was an engagement in Caldera Bay, a short distance north of Valparaiso, Chile, in which the insurgent vessel, the Blanco Encalada, was sent to the bottom by a torpedo. This vessel was a fine steel armored cruiser of 2,000 tons register and 3,000 horse power, carrying sixteen guns and having one torpedo tube in her bow. At 3 o'clock in the dark morning of April 23, as she lay at anchor in the bay, with her fires banked, her lookout discovered a light to seaward, which events soon proved to be the electric search light of a government torpedo boat, the Almirante Condell. The light was temporarily obscured by clouds, but in a few minutes two small vessels were discovered bearing down on the Encalada, the other vessel being the Almirante Lynch, another torpedo boat. The officers and crew of the Encalada were quickly in position, but the Condell discharged the first torpedo, which missed its object, the Condell at the same time opening fire with her Hotchkiss guns, in which she was similarly followed by the Almirante Lynch. The Encalada at this time was compared to a huge whale attacked on either side by swordfish. The Lynch next sent a torpedo at the Encalada, which missed, as did also one sent by the Encalada at the Lynch. The Condell then fired two more torpedoes, both of which went wide of the mark, and in return received a shot from one of the Encalada's heavy guns, which killed four men and shattered the rear smokestack, the storm of projectiles from the Hotchkiss and other guns in the meantime making sad havoc with the upper works of the Encalada, and covering her decks with killed and wounded. Twice more did the Lynch send out torpedoes unsuccessfully, the two torpedo boats constantly changing their position around the cruiser. The seventh torpedo was fired by the Lynch when she was bow on to the starboard side of the Encalada. This torpedo, as was the case with the others, was exposed by the search light of the Encalada, and a storm of projectiles was directed at it, to sink it on the way, but this proved ineffectual, and the torpedo struck the Encalada just abaft her foremast. There was a tremendous explosion, and a huge hole extending below the water line was made inside of the vessel, which immediately began to settle and went down in a few minutes. Of the two hundred officers and men on board, one half perished. The Encalada was provided with a torpedo net, but the attack was so unlooked for that this means of defense was not placed in position, and, as she had not sufficient steam up, she was in a peculiarly defenseless position to resist an attack from two such formidable assailants.

The Condell and the Lynch were built by Laird Brothers, of Birkenhead, England. They are sister boats, each 240 ft. long, 27 ft. 6 in. broad, and about 14 ft. deep, with a flush deck, high forecastle and half poop, drawing 8 ft. forward and 11 ft. aft, with a displacement of 750 tons. Each has a steel ram, fitted with a bow torpedo discharge tube, two torpedo tubes being also mounted on the deck on each side of the bow, making five torpedo tubes for each vessel. These are on the Canet system, of which a full account, with illustrations, was given in the SCIENTIFIC AMERICAN of January 31, 1891. On the forecastle are mounted two 14 pound Hotchkiss guns. The conning tower, of 1 in. steel plates, is covered with a steel hood on which is a flying bridge carrying the search light and the mounting for two Gatling guns. Inside the conning tower are telegraphs, steering gear, torpedo discharge and directing gear, so that practically the commander can control, by himself, the movements of the vessel. On the main deck are also two 3 pounder Hotchkiss guns. There are four locomotive boilers, designed for a working pressure of 155 pounds per square inch, each boiler being so arranged that it can be cut off from the rest in the event of a shot disabling any one boiler, while steam cannot escape from the undamaged boilers. The engines are triple compound, with cylinders 22 in., 33 in., and 49 in. in diameter, and having a stroke of 21 in. The propellers are of manganese bronze, three-bladed, and are 8 ft. in diameter, having a mean pitch of 9 ft., and a combined total area of 42 square feet. The vessels, on their official trials, both proved themselves fully capable of making 20½ knots per hour, and after the trials had been made, every part of the machinery was said to be in perfect order. The vessels were each supplied with eight torpedos from the Whitehead factory at Fiume, the torpedoes being of the service size, 14 in. in diameter by 14 ft. 6 in. long.

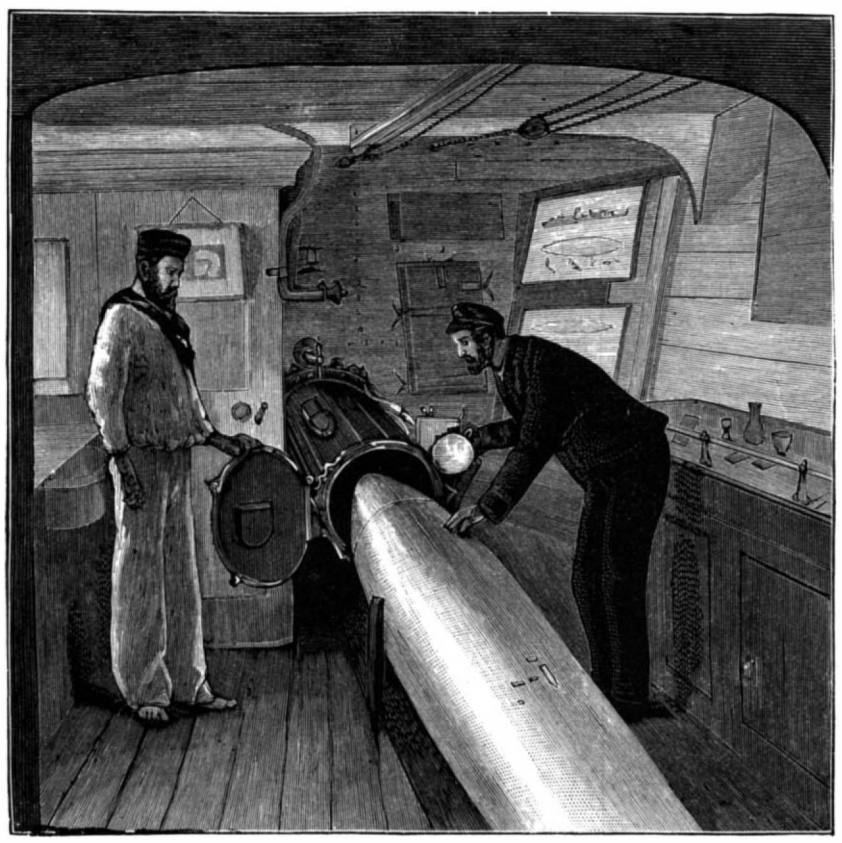


LAUNCHING TORPEDOES.

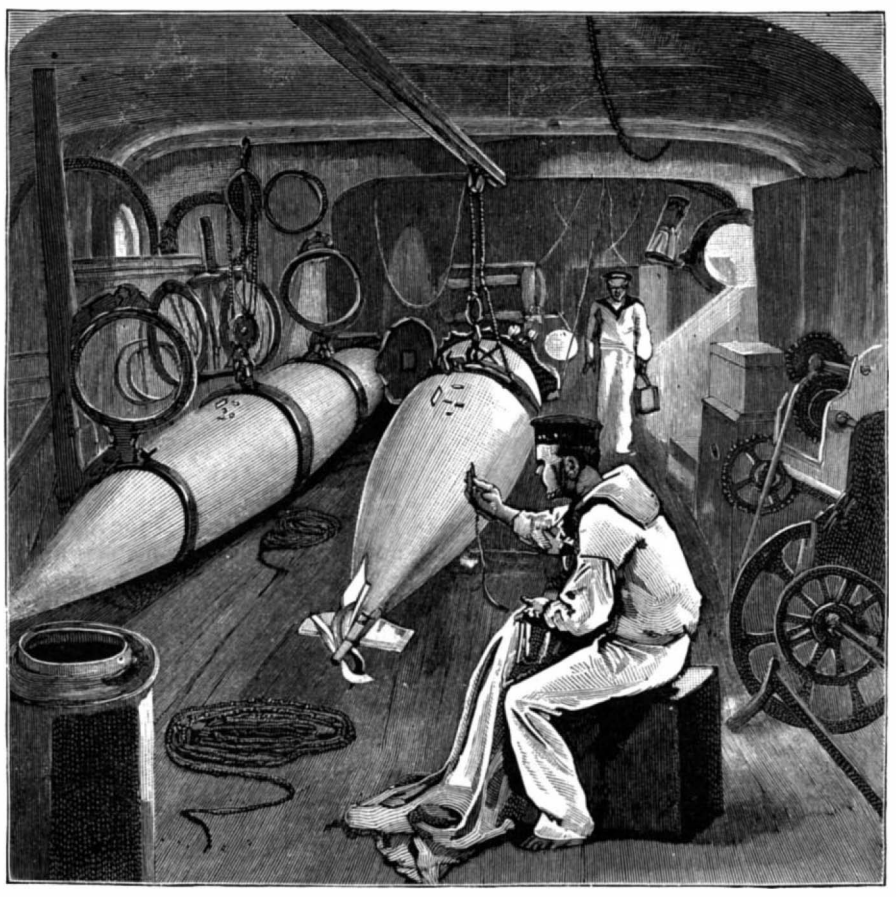
The Whitehead torpedo consists of a cigar-shaped envelope of steel or phosphor bronze, containing six compartments for its propelling, directing, and exploding mechanism. Its motive power is compressed air; it is propelled by two two-bladed screws revolving in opposite directions about the same axis, in order to neutralize their individual tendencies to produce lateral deviation, and it is maintained at a constant depth by horizontal rudders, and in a straight course by vertical vanes set at an angle predetermined by experiment. The latest models, fish-like in shape, full forward, and with a fine run, have attained a speed of 30 knots for 425 yards and 24 knots for 875 yards. The forward compartment or magazine contains the explosive cartridge, which consists of a series of disks of wet gun cotton perforated in their centers to receive the priming tube of dry gun cotton. Here also is the firing arrangement, which can be unfastened, withdrawing the primer with it, and so rendering the torpedo harmless. Behind the magazine is the secret chamber containing the immersion regulators, which so control the horizontal rudders as to carry the torpedo down to a given depth and keep it there during its journey. Behind that chamber is the reservoir for compressed air, and in rear of that the engine which this force actuates. Behind the machinery compartment comes the buoyancy chamber, the purpose of which is to bring the torpedo to the surface, so that it may not be lost during experiments, or, on the other hand, to sink it in actual warfare if it misses its target or fails to explode. Then come successively a compartment containing the bevel gear, which causes the propellers to revolve in opposite directions, and finally the rudder support and rudders.

The mechanism of the so-called secret chamber consists of a combination of springs, a hydrostatic balance, and a pendulum, connected by numerous cranks and rods with the horizontal rudders. The force of the springs and the pressure of the water upon the hydrostatic piston are to counterbalance each other, while the swinging of the pendulum, which is vertical, when they do thus counterbalance, causes the rudder to be turned upward or downward until the torpedo comes back to an even keel. The torpedo is started and discharged from the tube by a small charge of powder. One size of this torpedo weighs about 650 pounds, and is 19 feet in length.

One of our engravings shows a torpedo boat in the act of discharging torpedoes from the low sides and stern. Another cut illustrates the mode of inserting a torpedo within the discharging tube. The latter has a movable breech somewhat like a breech-loading can-



PUSHING A TORPEDO INTO THE TUBE.



PREPARING THE TORPEDOES FOR ACTION.

non. Another of our engravings shows the rear end of a torpedo, with the double propellers. This engraving also shows the mode of storing torpedoes on shipboard. They are secured, one over the other, in iron rings or clamps which are attached to the walls of the vessel.

Interesting Exhibits.

At the recent conversazione of the Royal Society at Burlington House, London, two photographs were shown of the colors of the spectrum by M. Lippmann, of Paris.

Among other exhibits were some iron tools and utensils of the Roman period, found together in a pit in the Romano-British city at Silchester, Hants, in September, 1890. These objects, about sixty in number, include an anvil, a pair of blacksmith's tongs, hammers, axes, gouges, chisels, adzes, a carpenter's plane, etc.

Dr. Oliver Lodge exhibited a revolving mirror for optically analyzing the nature of electric discharges, and other scientific purposes. The mirror is 2·3 by 1 cm., silvered back and front; very light, but giving fair definition. It makes 5,760 revolutions for one of the winding arbor. He also exhibited some resonant Leyden jars. Two independent but similar Leyden jar circuits were ranged at a moderate distance; the self-induction or capacity of one of them was adjustable, with an easy overflow path. On discharging one of the jars, the other resounded and overflowed, being provided with an easy overflow path. The oscillations were much more numerous than with ordinary linear —Hertz—vibrators, therefore some precision was demanded in the tuning.

Professor Roberts-Austen exhibited a method of recording pyrometric measurements at temperatures between 600° C. and 1,200° C. The apparatus was that employed in a research undertaken for the Institution of Mechanical Engineers, and is used for automatically recording, by the aid of photography, the indications of a platinum and platinum-rhodium thermo-couple. The experiments shown illustrated a method of recording the rate of cooling of heated masses of metal, and curves were shown to illustrate the kind of results which are obtained by the aid of the apparatus. The current from the heated couple deflects the needle of a dead-beat reflecting galvanometer, which throws a ray of light upon a horizontal slit about one one-hundredth inch wide, behind which a photographic plate is drawn.

Mr. Shelford Bidwell exhibited: (1) Selenium cells, the electrical conductivity of which is greater in the light than in the dark. (2) A selenium lamp lighter, lighting an incandescent lamp automatically when darkness comes on. (3) A selenium alarm, for calling attention to the accidental extinction of a ship's light or railway signal lamp. He said that the influence of light upon the electrical conductivity of selenium was first noticed by Mr. Willoughby Smith in 1873. It is advantageous to arrange the selenium so that it may expose a large surface relatively to its volume. The electrodes at the same time should be large and near together. Several contrivances, known as "selenium cells," have been proposed, in which these conditions are more or less perfectly fulfilled. In the cells exhibited two fine copper wires, serving as electrodes, were wound very close together upon a slip of mica, one side of which was afterward coated with a thin film of selenium. A small electric current passing through such a cell is varied by the action of light sufficiently to enable it to work a delicate relay, by means of which a bell may be rung, or an incandescent lamp turned on, as in the experimental apparatus exhibited.

Mr. William Crookes exhibited some experiments on phosphorescence in high vacua. Diamonds subjected to the molecular stream phosphoresced different colors, according to their origin. Thus, Cape diamonds usually phosphoresce blue; Brazilian diamonds phosphoresce red, orange, blue, and yellow; Australian diamonds phosphoresce yellow, blue, and green. Zinc sulphide, Sidot's hexagonal blende. This is the most brilliantly phosphorescent body yet met with. In the molecular stream it begins to phosphoresce at an exhaustion of several inches below a vacuum. At first only a green glow can be seen; as the exhaustion gets better a little blue phosphorescence comes round the edges. At a high exhaustion, on passing the current, the green and blue are about equal in brightness, but the blue glow vanishes immediately the current stops, while the green glow lasts for an hour or more. Some parts of a crystalline mass of blende which, under the action of radiant matter, glow of a bright blue color, give a green residual light when the current ceases; other parts which glow blue become instantly dark on stopping the current.

Dr. Emerson Reynolds exhibited samples of the reversal of the photographic image owing to the use of certain thiocarbamides in the developer, a discovery made and worked at during the past year or two by Colonel Waterhouse, Assistant Surveyor-General of India.

NEW TAPER ATTACHMENT FOR LATHES.

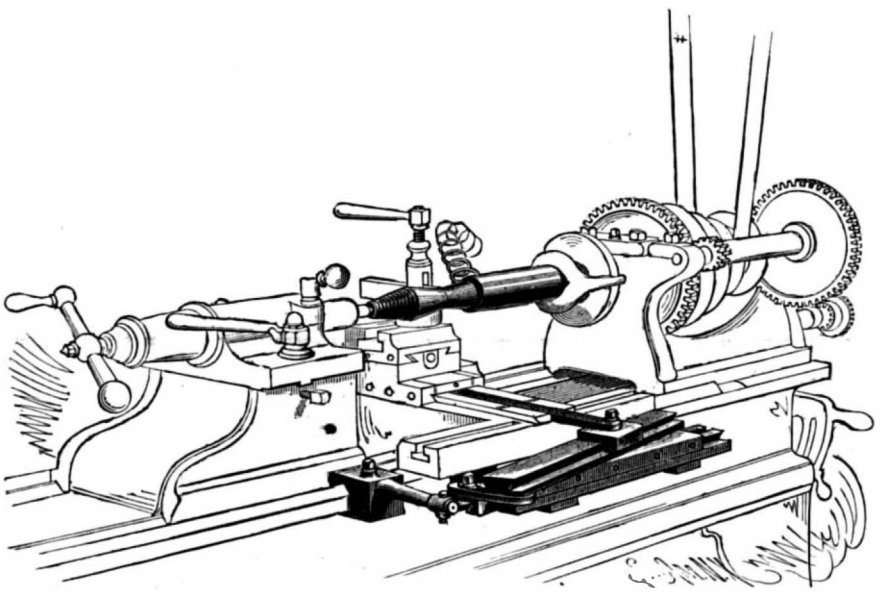
In engine lathes, as ordinarily constructed, a long taper is turned by setting the dead center of a lathe eccentrically with reference to the axis of the lathe mandrel, and short tapers are sometimes turned by means of a slide rest adjusted at a proper angle. These methods, however, are unsatisfactory, on account of the difficulty of adjusting the lathe so as to produce a taper of a given angle.

The annexed engraving illustrates a valuable improvement designed for attachment to an engine lathe, which admits of duplicating tapers of any angle without regard to the length of the bar upon which the tapers are formed. It also provides for accurately boring holes for fitting these tapers. It is the invention of Mr. L. L. Lord, of 936 Market Street, Meadville, Pa.

The cross feed screw is detached from the tool rest, and to the carriage are attached a pair of arms, which support the lower guide, which is arranged exactly parallel with the lathe shears.

To the lower guide is fitted a slide which is attached to an adjustable arm projecting rearwardly from the lathe shears. To this slide is pivoted the upper guide, which is widened at the end and provided with a curved slot for receiving the bolt which clamps it to the slide in any desired position. To the upper guide is fitted a narrow sliding block, which is pivotally connected to a bar projecting rearwardly from the tool rest. This bar is accurately fitted to ways in the carriage, so that it causes the narrow sliding block to move with the carriage.

The upper guide being set at the required angle, the turning of the taper proceeds in the same manner as turning a cylindrical bar, the sliding block being moved inwardly or outwardly by virtue of its engagement with the upper guide. By the use of this attachment, tapers may be turned as smoothly as cylindrical surfaces. Tapering holes are bored by replacing the turning tool with a boring tool and proceeding in the usual manner, the attachment causing the tool to move toward or away from the axis of the lathe, as may be required to produce the taper.



LORD'S TAPER ATTACHMENT FOR LATHES.

Good Words to Young Workers.

At the recent exercises of the graduating class of Packard's Business College, in this city, held in the new Carnegie Music Hall, Mr. Roswell G. Horr, of Michigan, delivered an able address. We make a few extracts:

The human race as a whole will never be able to get an honest living without some kind of labor. It is better for us all that we must work in order to live. I can conceive of no planet that could be filled with a more miserable set of human beings than to fill one up with a lot of do-nothings—with a mass of people who have no aim in life, nothing to do worth living for. To-night I desire to give a few practical hints as to the coming lives of this graduating class.

In the first place, never cease to be teachable; always have the courage to say "I do not know"—that is, when you do not know. Never assume to have knowledge that you do not possess. To attempt to explain anything that one does not clearly understand always leads to difficulty; confusion is sure to follow. Besides, in a world like ours, where there is so much to learn, it is really no evidence of unusual ignorance once in a while to say "I do not know." I doubt if in this large audience there are over half a dozen of us who know everything.

Again, be modest in all your life work. When you are working for a firm, do not claim to own all the property of the concern, or intimate that you manage most of its affairs. It is not very desirable that you should consider yourself indispensable to the work you are doing. It is most fortunate, though, if you can make your employer feel that you are exceedingly useful. Do not forget that you will be a confidential clerk for those that hire you. The secrets of physicians, the confidences imposed in lawyers, the utterances of the confessional, should be no more sacred than are the doings and sayings of those for whom you labor. Never betray those who trust you.

A word to you young men who will deal in numbers and keep accounts for the business men who employ you. Your work is a difficult one and a very important one. The figures which you will use—the nine digits—and the cipher are all naturally honest. Their every-day appearance suggests integrity and no suspicion lurks in their countenances. So strong is this peculiarity that out of it has grown the proverb that "figures never lie." They do not, eh! That depends entirely upon whether they are honestly arranged. A dishonest man behind them can make figures lie worse than tombstones.

It is wonderful how few real blessings there are that any person who lives by labor cannot enjoy just as well as the men who roll in wealth. The millionaire cannot surpass you in his appetite for food; he cannot coax any sweeter or more restful sleep. The air is just as pure and bracing for you as it is for him. He cannot love his children any better than you can love yours; cannot be any truer to his friends.

Do not, I beg of you, join the army of croakers and faultfinders. There can always be found in this world plenty of things to find fault with, so there can always be found an untold number of blessings. Never stop to worry because some people are better off than you are; rather keep your hearts full of thankfulness because you are so much better off than are thousands of other human beings.

What I would like to do here to-night is to warn every one of these young men and young women as they start out in life to avoid as much as possible all feelings of dissatisfaction and discontent with their lot. If I could but give you each and all courage to meet the great battle of life, if I could only stir up within you a determination always to be faithful to every trust and always true to yourselves, then my task would be complete. I have often thought that the man who blesses the world most is one who organizes some great industry which furnishes labor, well paid labor, for large numbers of his fellow creatures. Such a man, if he is faithful to his business, kind to those who work in his factory or shop, considerate to the needs of all his employes, is a blessing to the world. He carries comfort to so many human beings on every pay day. It matters not to me if his dividends enable him to carry comfort to his own family also. Alongside of such a man I will place the one who inaugurates such an institution as the one whose commencement we celebrate here to-night—President Packard; the man who teaches people how to work, who prepares them for usefulness.

Dangers of Sulphonal.

Although sulphonal is probably one of the safest, as it is one of the most efficacious, among the hypnotics recently introduced, the series of cases published by Bresslauer, of Vienna, show clearly that it has certain dangers. The degree of peril is difficult to estimate, as the patients were lunatics, and were also apparently feeble; but the fact is significant that out of seventy-seven patients who were treated with the drug, no less than seven showed serious symptoms, and in five of these there was a fatal termination. It ought to be mentioned that the patients had been taking the drug for a considerable time in good doses, and had borne it well until symptoms of disturbance set in, these being great constipation, dark brown urine, slow or in some cases rapid but feeble pulse, discolored patches resembling purpura on the limbs, and great prostration. In the cases which ended fatally, the cause of death was heart failure, with œdema of the lungs.—*Lancet.*

New Italian War Vessels.

Two fine steel cruisers, the Etruria and the Umbria, have been launched from the yard of Messrs. Orlando Brothers, at Leghorn. They are provided with armored bridges, and are each of the capacity of about 2,300 tons. Their length is 80 meters, beam 12 meters, and depth 8·6 meters. The engines, which have been constructed at the works of Messrs. Orlando, are on the triple expansion system, and develop 6,500 h. p. A speed of 19 knots per hour will be attained. The designs of these vessels have been made by the Italian naval authorities, and the engines have been designed by Messrs. Orlando. The engines are intended to develop the maximum of power with the least possible weight, and are said to combine all the latest improvements in naval engineering.

West Superior.

Ten years ago West Superior, Wisconsin, was unknown. To-day it is a city of over 17,000 inhabitants, the seat of great commercial and manufacturing enterprises, the subject of vast hopes. The *Commercial Record* says:

Situate as this city is, at the head of navigation, the export of the products of the prairies of the West cannot but be large, especially as the facilities for handling grain are unsurpassed. The grain elevators here have a capacity of 8,500,000 bushels, while just across the bay at Duluth the storage capacity is no less than 12,500,000 bushels, or a total of 21,000,000 bushels for the two cities.

Here the wheat is graded and shipped to the seaboard, whence a large percentage is exported. The long distance by water through the several lakes makes this the cheapest route, and as a consequence, the ports at the head of Lake Superior have wrested the supremacy from Chicago, and as soon as the Sault Ste. Marie canal is enlarged, this traffic in grain shipments will largely increase, especially as the wheat belt of the country is moving north and leaving rail haul to this point without a competitor. The Northern Pacific and Great Northern roads will here ship the products of the Canadian northwest in addition to that from the Northwestern States, and the amount of wheat to be handled here the coming season will be greatly in excess of that handled any previous year, as the snowfall throughout the whole wheat-producing area has been greater than for several years, and in Dakota more than has fallen during the past three years. The soil this spring will have more moisture than for years, and on this account a large yield is a certainty. Vessels can afford to carry this grain cheaply, as all have full freights each way—coal and merchandise on the up trip and wheat and flour going east. When the vast area of agricultural lands tributary to this point is considered, the amount of grain shipped from the head of the lake may be made to amount to the capacity of the carriers, and vessels of larger carrying capacity are imperatively demanded. In 1890 there were shipped from West Superior 9,318,336 bushels of wheat and 1,383,390 barrels of flour, while 1,045,000 tons of coal had been received. During the same year Duluth shipped 4,556,371 bushels of wheat and 1,112,610 barrels of flour, while 619,656 tons of coal were received. This is certainly a magnificent showing, and the amount of wages paid at this point for the handling of freight here is no mean factor in the support of the city.

The elevators are so arranged as to handle grain rapidly and cheaply. Steamers of the largest capacity can be loaded in an incredibly short time, while the facilities for taking grain from cars are of the very best. Owing to the care taken in grading wheat shipped from this point, it is in demand in the East, and arrives in better condition, and gives better mill results.

Flour can be manufactured here from fifteen to twenty-five cents cheaper than at any other place on this continent. The matter of fuel alone is no less than four cents a barrel in favor of this place. Shipping, switching charges, interest on property required for a site, and other things which cost at other points. Free sites can be secured, while Chicago and other cities have a heavy tax on this capital. The flour can be shipped by water direct from the mills, which gives another profit.

The Insane.

The total number of insane persons treated in both public and private institutions during the year 1889, as given in Census Bulletin No. 62, was 97,535, while during the year 1881 there were 56,205 treated, showing an increase in the nine years of 41,330, or 73·53 per cent. This percentage of increase, when compared with the percentage of increase of population in the last decade, namely 24·86, does not indicate an increase in the proportion of insane persons to population, but rather a great increase in the amount of asylum accommodation provided and a willingness on the part of the public to make full use of all the facilities thus provided. The figures for the actual number of insane in the United States cannot be determined until the work of eliminating all duplicate reports of cases has been completed.

MENDING A BIG SHAFT AT SEA.

The kind of engineering skill that is equal to a great emergency is as rare as it is valuable. There are times in the experience of almost every engineer when fixed rules and ready-made appliances are of no value, and the engineer is compelled to rely upon his own resources. No better opportunity for the exercise of skill of this order can be imagined than in the case of a breakdown of a great steamer in mid-ocean, where the appliances usually carried on board for emergencies generally, or at least often, happen to be of the sort required for some other purpose.

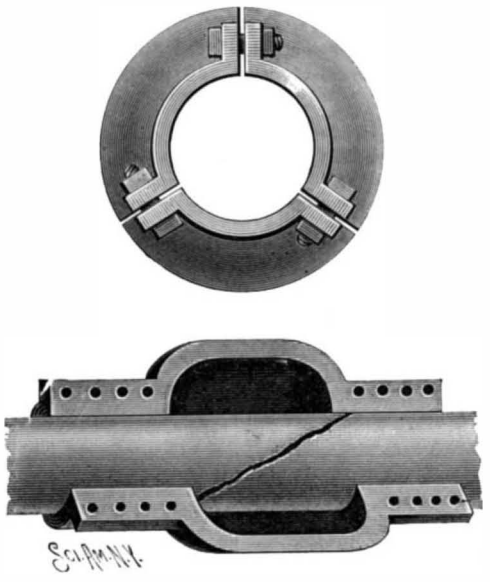


Fig. 1.—THE THOMPSON COUPLER.

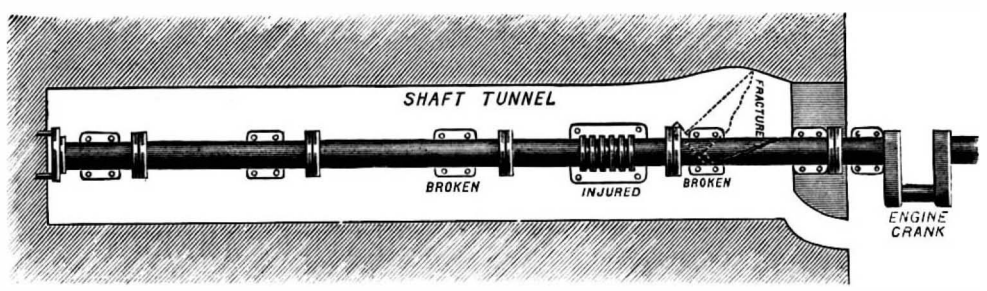


Fig. 2.—PLAN OF SHAFT TUNNEL.

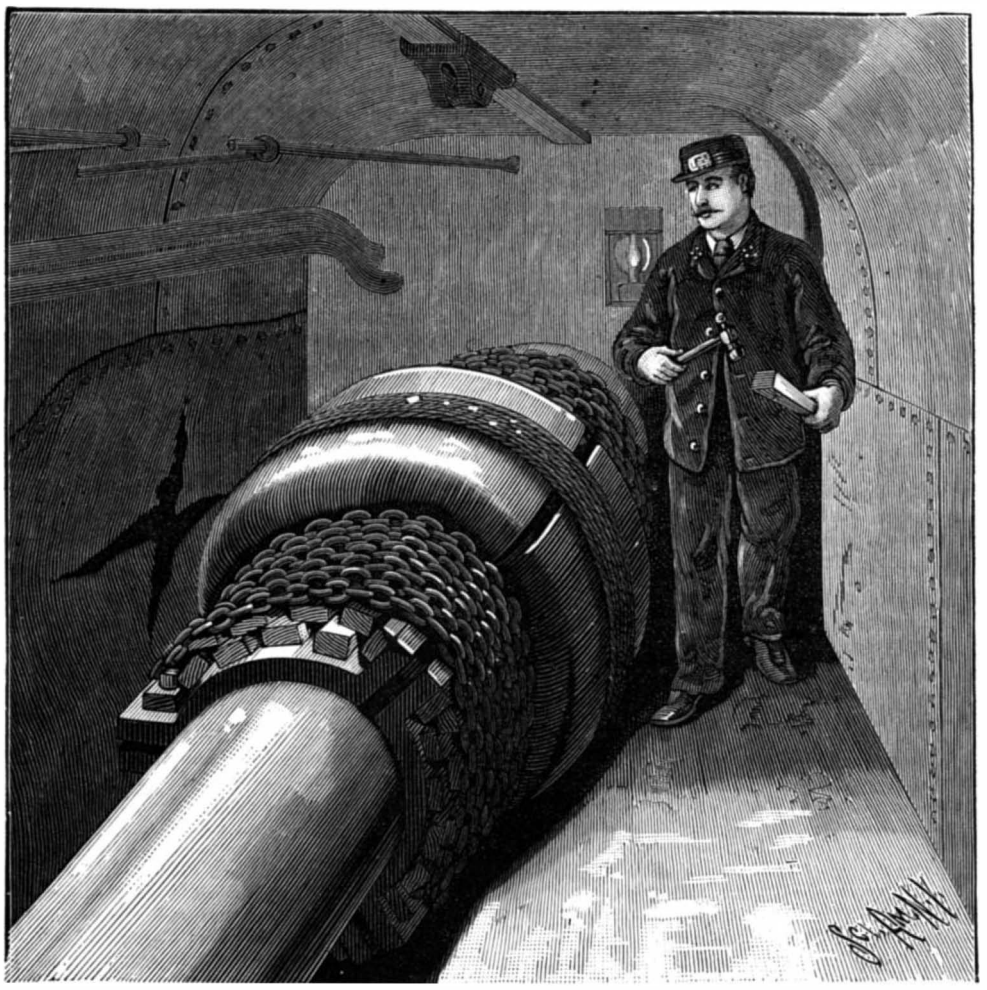


Fig. 3.—A BROKEN SHAFT REPAIRED AT SEA BY MEANS OF THE THOMPSON COUPLER, RE-ENFORCED BY CHAINS AND CABLES.

A splendid example of engineering skill is seen in the patching up of the shaft of the steamer Veendam, of the Royal Netherlands & United States Line, on her last voyage. The accident, which occurred in mid-ocean on Friday, May 15, resulted in the breaking of the screw shaft, the destruction of one of the bearings, and injury to the thrust block. The break in the shaft was a diagonal one 21 inches in length. The shaft is 16½ inches in diameter, 22½ feet long, and weighs about ten tons. When the break occurred, the continued motion of the part of the shaft adjoining the engine acted as a cam, pushing the other part of the shaft laterally, breaking the pillar block and two of the couplings, and straining the thrust block. The shaft was shored up, the broken bolts of the couplings replaced, and a device known as the Thompson coupler, carried in the hold of the vessel for such emergencies, was applied to the break. This coupling consists of a sleeve formed of three parts and having a bulge in the center for inclosing the ordinary flange coupling. An end view of the coupling, and a perspective view of one of the parts, is shown in Fig. 1. These parts are provided with flanges having bolt holes in which are inserted heavy bolts for drawing them together and bringing the coupling into firm contact with the shaft. The difficulty of accomplishing this work will be appreciated when it is known that in the shaft tunnel there is room only for four men to work.

It required three days to apply the coupling. The engines were started up under slow speed, but at the end of seven hours, owing to the wabbling of the shaft, the point of the shaft broke off, eight of the coupling bolts gave out, and the coupler cracked. The engines were again stopped, and the coupling was re-enforced by heavy chains and wire ropes, as shown in Fig. 3. The chains and ropes were made as taut as possible in wrapping them about the coupling. Wooden wedges driven between the chains and the coupling exerted a pressure upon the coupling which was sufficient to create the friction required to turn the screw. With the shaft thus repaired the steamship made her way to this port under reduced speed, arriving here Wednesday, the 27th ult.

The exact cause of the fracture of the shaft cannot be ascertained until the shaft is removed for repairs. The screw may have come into contact with a submerged object, or there may have been a flaw in the shaft. Great credit is due Captain Roggeveen and Chief Engineer E. H. G. Savenoye for bringing safely into port the steamship, which, with less competent engineering, might have gone to the bottom.

Phenomenal Friction.

When making experiments during the month of February, 1891, with the Thurston railroad testing machine, I noticed the ease with which the axle box could be made to slide longitudinally upon the axle when the same was in motion.

The several boxes tried had about fourteen square inches of surface in contact with the axle; they were variously loaded, with weight from 262 pounds upward, and the axle was running at speeds varying from 160 to 400 revolutions per minute. One box could be moved by a pressure of one ounce when the axle was running, but required thirty-two pounds to move it when the axle was still.

Another box was moved by four ounces with motion, but required forty pounds without motion of the axle. A third box under considerable pressure could be moved readily by a pull of six ounces, but fifty pounds would not start it when the axle was still, and, indeed, on trial, all the muscular force I could apply to it by my hands, with my foot against the machine, failed to start it. A spring balance was used in these experiments, for pulling the box in a line parallel to the axle.

Here we employ forces anywhere from 160 to 1, up to perhaps 1,000 to 1, for moving the same body, under the same load and conditions, except that of the revolving or standing shaft beneath it. This phenomenon of friction proved a marvel to all who witnessed it. The temptation was great to theorize upon the extraordinary performance, but no theory was offered in explanation of it. A practical suggestion was made, however, in reference to planer bed motions, and the like, which drag so heavily upon their fixed ways. If, as then proposed, revolving shafts were placed in the bed-ways, and the table fitted to them, a pound pressure would move the table and its load back and forth on the revolving ways, where 1,000 pounds or more would be required to do this work upon the usual fixed V's of planers, as they are generally built. To the writer, this unique action, as if the loaded box were floating, was an instructive object lesson in mechanics.—*John H. Cooper, Jr. Fr. Inst.*

THE great telescope of Lord Rosse has a speculum 6 feet diameter, 55 feet focus.

RECENTLY PATENTED INVENTIONS.

Engineering.

HYDROCARBON BURNER. — John W. Coone, Thompson, Pa. This is an attachment for an automatic engine having a hydrocarbon burner for generating steam, and consists of a small boiler with heater and steam pipe connection to the atomizer of the burner used in heating the engine boiler, dispensing with the air pump and providing an effective substitute which will operate the injector until the engine boiler contains sufficient steam to operate the injector.

PROPELLING VESSELS. — Ernst W. Gram, Las Vegas, New Mexico. The hull of the vessel is, according to this invention, made with a stern of peculiar recessed construction, adapted to accommodate a pair of paddle wheels having vertical axes and arranged to work within opposite sides of the recessed stern, while a screw propeller on a horizontal axis works centrally within and through a reduced portion of the stern in rear of the paddle wheels. The recessed construction of the stern is designed to secure efficient action for the upright paddle wheels, in addition to the action of the screw propeller in their rear, the paddle wheels also affording great facility in turning or steering.

Railway Appliances.

FROG. — David Horrie, Antigo, Wis. Combined with a shifting rail pivoted on a bed plate to swing laterally and align with main track rails or side track rails, is a transverse draught bar, a tripping bar, a latch dog, an elongated bracket plate which the latch dog is pivoted on, and a device to slide the latch bar longitudinally, affording a switch or track crossing designed to dispense with frogs, and afford means to automatically lock the shifting frog rail in connection with a main track and release it in a similar manner when the frog rail is thrown to align with a side track or a track that crosses the main track.

CAR COUPLING.—George B. Benjamin, Danbury, Conn. This device has a fixed horizontal upper jaw whereon a coupling pin is pivoted by one end, and adapted to fold forwardly or rearwardly in a channel of the jaw, a lower jaw being jointed to the upper jaw by its rear end, and slotted to receive and interlock with the pin, while a slide bar is adapted to normally retain the lower jaw parallel with the upper jaw by its gravity, and depress the engaged lower jaw when the bar is lifted. Cars provided with this improvement will couple automatically, while the coupling may be released from either side or the top of the car.

CAR COUPLING. — Frank G. Nixon, Chalk Mound, Kansas. The drawhead of this coupling has a chamber open on top and in front, and contracted to form a narrow front passage with forward shoulders and a narrow rear recess, into which extends a spring, while a spring-actuated push bar is located in a groove in the bottom of the chamber, and a link journaled in the rear recess has a rearwardly extending finger, and a transverse shaft is journaled in the drawhead beneath the push bar, an eccentric on the shaft engaging the bar. This coupling is designed to be automatic in action, while it can also be used in connection with the ordinary link and pin coupling.

Electrical.

TELEPHONE TRANSMITTER. — Philip Fitzsimmons, Birmingham, Ala. This device has a carbon electrode in the shape of a pencil or flat bar, having its ends tenoned or reduced in size and entered in sockets in carbon blocks fastened to the supporting board, so that it may readily vibrate from the action of the sound waves. This transmitter has no diaphragm, and is constructed without any box or case, so that it may be readily transported and hung up like a picture frame at different points in a building. It is designed to give a clear tone and full volume of sound, enabling one to hear at a distance from the transmitter.

Mechanical Appliances.

PLANING AND SIZING MACHINE.—Hiram N. Berry, Meridian, Miss. Two horizontal parallel beams constitute the main frame of this machine, between which are journaled the feed rollers carrying the lumber through it, the machine being adapted to receive lumber from a saw mill on live rollers, and reduce the lumber to exact transverse sizes, planing its surface as it passes through. The invention may be used in connection with a mill sawing green or dry lumber, sizing and planing dry lumber of any width or thickness, or it may be used as a separate machine, disconnected from any saw mill.

MECHANICAL MOVEMENT. — Werner Suess, Washington, D. C. Shafts at oblique angles to each other have gear teeth secured upon them by universal joints, with guides to hold the wheels in position to mesh, whereby two shafts arranged at oblique angles and in a common plane may be geared together without the intervention of bevel gears. The invention also provides for two shafts to be arranged at oblique angles and not in a common plane, and to be geared without the use of bevel gears. The guides are carried by arms projecting from a plate below the wheel or pulley, or upon arms projecting horizontally from a vertical wall, or descending from a ceiling, like hangers.

GAUGE. — Charles W. Morrill, Butte City, Montana. This is a simple and inexpensive implement designed to be movably attached to a rule square blade, yard stick, or other graduated measure of length, and afford means for marking off parallel lines on any plane surface. It is constructed of metal and provided with a table having a border flange and a guide flange, a yoke clamp being secured on the table and a set screw in one of the limbs of the clamp.

SAW MILL CARRIAGE. — Jacob Bickhart, Cadillac, Mich. This invention relates to a side throw mechanism for saw mill carriages, especially to the carriages of band saw mills, providing a simple and durable means whereby the carriage, with log attached, may be conveniently and expeditiously set away from the saw a proper distance after the slab or board has been cut, to enable the sawyer to gig back the carriage without danger of throwing the saw from its pulley by reason of a sliver, knot, or other projection on the log engaging with the back of the saw. A rock shaft is mounted in supports below and independent of the carriage, and has arms engaging the carriage body, while means are provided for operating the rock shaft.

WHEEL LUBRICATOR. — Tolbert J. Robison, Curwensville, Pa. This is a lubricator for car wheels, loose pulleys, etc., the wheel hub having a transverse open ended oil chamber or receiver, with openings leading to the axle box, in combination with a plug having a longitudinal bore and externally threaded at its outer end, there being a valve outside of the plug, with a stem entering the bore, while a spring bears against the inner face of the valve and presses it away from the plug. The device is simple and effective and not liable to get out of order.

Agricultural.

PLANTER.—Adolphe Kleiser, Portland, Ala. This is an improved corn and cotton seed planter, designed to drop the corn or seed at predetermined intervals, and provide means whereby the cotton seed will be separated before being dropped. This implement is especially adapted to plant some corn between the cotton, about fifteen to eighteen feet apart, in order not to injure the cotton crop, the implement planting the corn and the cotton seed at the desired intervals.

Miscellaneous.

DESK CABINET. — George C. Harding, Chicago, Ill. This is a composite cabinet structure intended for use on the writing desks of business men, etc., providing a neat appearing and inexpensive receptacle for the various requisites of such a desk, in the way of ink bottles and wells, pen and pencil racks, postage stamps, rubber bands, paper fasteners, sealing wax, band stamps, and the like. The cabinet also includes a perpetual calendar adapted to be easily set by an ordinary pencil or stylus.

ENVELOPE MOISTENER, ETC.—William E. Brown, Kansas City, Kansas. This is also a stamp feeding, attaching and detaching device, as well as an envelope moistener. The base carries a moistening sponge, for dampening the corner of an envelope, and there is a vertically adjustable flap-moistening device for dampening the gummed flap, with a stamp-carrying and feeding reel, and a swinging platform on which the envelope rests when the stamp is fed and attached, the platform being adapted to be swung away from the base, whereby the attached stamp is detached from the adjoining one. All the parts of the device are detachable, permitting it to be neatly packed in a small space.

ADVERTISING DEVICE.—Charles Cleveland, Denver, Col. Combined with a base plate on which is mounted a frame is a cylinder inclosing the frame, and having an inwardly extending annular plate with depending rails, shafts being mounted in the frame and having pulleys to engage the cylinder rails. Advertisements are designed to be attached to the outside of the cylinder, and as the latter is revolved various advertisements are brought to view in a novel manner designed to attract attention.

DENTAL MALLET.—William H. Dibble, Brooklyn, N. Y. This mallet has a tube with a central opening for the admission of air, a plunger sliding in one end of the tube, while a spring-pressed plugger is held in its opposite end, with means for connecting the plunger and plugger, so that the plunger will operate the plugger when near the end of its stroke. The mallet is designed to be operated with one hand, and has a back action, so that the plugger will deliver a blow when moving toward the operator, thereby enabling him to work conveniently on the back part of a tooth.

MUSIC HOLDER. — Simeon T. Walker, Olathe, Kansas. This is a device to be applied to various styles of music racks, to hold books or sheet music in position thereon, and hold the leaves of the music open as desired. It consists of horizontal arms supported on each side of the rack, with blocks longitudinally movable on the arms, the blocks having extensions and inwardly projecting spring fingers secured to the extensions to clasp the music. The holder may be adjusted to any sized sheet or book, and means are provided for conveniently throwing light on the music.

LATCH. — William H. Bell, New York City. Combined with a casing having a bolt opening and inclined slideways at opposite sides of the opening, is a latch head having wings at its sides, the outer ends of the wings being beveled. The construction is such that, by pulling or pushing the door in the direction in which it is hung to swing, the door may be opened without turning the knob, thus facilitating its being readily opened by persons carrying parcels or having their hands occupied. A lock is also provided with a keeper or locking bolt in addition to the ordinary latch, the bolt and latch to be simultaneously operated in the same manner.

SPRING HINGE. — Walter R. Webster, Pine Grove, Cal. This is a device for automatically closing the lids of water closets the moment that the seat is unoccupied, and is applicable to any form of closet. Spring hinges connect the casing and the lid, the springs of the hinges being coiled in opposite directions, and blocks attached to the seat are connected with the hinges, whereby when the lid is raised the seat is lowered, and when the lid is lowered the seat is raised.

WATER CLOSET LIDS.—This is another invention of the same inventor for a device for automatically closing the lids of water closets, and retaining the lids in closed position the moment the seat is unoccupied, the device being simple and durable and capable of convenient attachment to the seat and cover of any form of closet.

WHIFFLETREE HOOK. — Albert C. French, Monmouth, Ill. This hook has its forwardly projecting portion bent to incline not only upwardly but also to project inwardly relatively to the length of the whiffletree, while its inward and upper end has two curved horns at right angles to the forward part of the stem portion of the hook. The device is more especially intended for horse or draught agricultural implements and machines, to prevent the cockeye on the end of a harness tug from working off the hook or becoming accidentally detached.

FOLDING METAL COT OR BEDSTEAD. —Edwin F. Tilley, Brooklyn, N. Y. This invention relates to an improvement on a former patented invention of folding iron bedstead, affording an improved construction of the folding parts in connection with an angle iron main frame within which the legs and their stays close when shut. A simple and inexpensive bedsted is thus provided, which admits of being contracted when folded into a very shallow depth of space and flat form to facilitate transportation, while it is very substantial when unfolded and set up for use.

WASHING MACHINE. — William H. Haire, Morristown, Tenn. This machine has an agitator frame composed of a single bar of metal bent into elongated rectangular form, having its side limbs flattened oppositely and perforated for pivotal support, a handle being loosely mounted on the upper cross bar of the agitator frame. The body of the machine is an elongated rectangular chamber, preferably of galvanized sheet iron, wherein the water may be heated for washing the clothes.

IRONING TABLE.—Herbert M. Landers, Marshfield, Pa. This is a collapsible table having a flat top with a recessed strip fixed to its under side, a pair of legs being pivoted to one end of the strip, while a pair of legs pivoted to the table top is adapted to extend diagonally across the other legs, braces pivoted to the longer legs having at their upper ends a rod adapted to slide in the recessed strip, and links connecting the braces with the shorter legs. This table may be folded in very small compass, and quickly and easily placed in position for use.

HAT GUARD.—William H. Thompson, Winnipeg, Canada. This guard is in the nature of a combination lock adapted to be secured to a hat in such a manner that when adjusted in its locked position it will prevent the placing of the heat on the head, and also form a convenient means for attaching a holding chain. The device is likewise adapted for use in connection with the ordinary spring lock or clasp of valises, portmanteaus, etc.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

Business and Personal.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(3050) E. J. F. asks: 1. A fox is due south of a hound any distance (*d*), and runs due east at any rate (*r*). The hound runs always directly toward the fox at any (*R*). How far does the hound travel before he overtakes the fox? What is the equation to the curve he describes? A. It would be a hyperbola or some curve of that order. The relative speed of the hound and fox would affect its nature. Theoretically, the hound would only catch the fox by departing from the original curve. 2. I notice in SCIENTIFIC AMERICAN the list of patented inventions, etc., appears but for one day in a week. Are patents issued only on one day each week? If not, why is the list given for only one day? A. They are issued only on one day, Tuesday, of each week.

(3051) E. H. asks how to make copper into a pliable body, into a mass like putty. I wish to get a pliable metal for moulding if such a thing is possible. A. Precipitate copper from a solution of the sulphate by adding zinc thereto. After washing, mix with concentrated sulphuric acid in a porcelain mortar. Add about double the weight of copper or metallic mercury. When the amalgamation is complete, which must be accelerated by rubbing, wash out the last traces of acid. A slight heat brings this to the consistency of wax.

(3052) W. H. B.—The number of applications for patents made in England, for the year 1890, was 21,300. The number of applications made in the United States for same period was 41,000.

(3053) J. T. C.—Send your name and address.

(3054) A. M. asks for a white substance or composition nearly approaching gutta percha in its properties. It must be no heavier than gutta percha and rebound like it when struck against a hard substance, but must not have anything of the nature of India rubber in its composition. Chlorine is said to bleach gutta percha into a white substance like ivory. I have tried liquid chlorine, but it does not have any effect. A. We would suggest celluloid or zylonite as answering your requirements as well as anything we know of. The following process is said to bleach gutta percha. Dissolve in 20 times its weight of boiling benzol, add one-tenth part plaster and agitate from time to time. After two days' standing decant the perfectly clear solution. Add it little by little to twice its volume of 90 per cent alcohol, agitating continually. The gutta percha is precipitated white.

(3055) C. T.—Reading an article in vol. 64, No. 17, on "Water Power in Motion," an argument arose as to whether there was any friction of water on pipe. Suppose we 'have 100 feet head and 100 feet of pipe, or 100 feet head and 400 feet of pipe, with the same

amount of water. From which could we obtain the most power, or would it be the same? A. The friction of water in pipe increases with the length with given heads. The shorter pipe gives the most power. See the "Power of Water, or Hydraulics Simplified," in SCIENTIFIC AMERICAN SUPPLEMENT, No. 788.

(3056) R. P. writes for a recipe for making and flavoring sirups for soda fountain. It is one of the older kinds. It has no gas reservoir, but the gas is formed by the combination of two chemicals, one in the flavor and the other in the fountain. What proportions of tartaric acid, flavoring and simple sirup in the flavoring extracts, and how much soda to a gallon of water in the fountain? A. For each quart of liquid use 4 drachms tartaric acid and 5 drachms bicarbonate of soda, all in powder. For simple sirup use 35 parts water to 65 parts sugar. Flavored sirups are very numerous. For sarsaparilla add to three gallons of simple sirup, 3 ounces extract of sarsaparilla, 2 ounces essence of sarsaparilla, 1 ounce extract licorice root, 1 ounce citric or tartaric acid. Color, if desired, with caramel. Use in quantity to suit taste, about 1 part to 5 of soda water.

(3057) T. D.—The estimated cost to fire a full round from one of the British war ship Victoria's great guns is about $2,500. These are 110 ton guns, the largest in the British navy. The charge is 960 pounds of powder and a projectile of 1,800 pounds. No full round has yet been fired. Next to the above are the 12½ inch guns of the Japanese navy lately tried at a stated cost for each round of $2,000. The cost of firing per round for the Chicago's 8 inch guns, using the cheapest kind of projectile, namely, cast iron shells, is $65.25; with steel projectiles the cost would be increased to $212.

(3058) H. S. writes: I live almost on latitude 29°. The sun never gets over 23°25′ north of the equator. Why is it that it seems to rise in the northeast and set in the northwest? I confess it puzzles me. A. The apparent daily motion of the sun is parallel with the equatorial plane. At the equinoxes the sun rises and sets east and west at all latitudes, save at the poles, where it skims the horizon all around the circle. As its declination increases, its point of rising and setting also moves to the north of east and west, increasing with the latitude, so that when it reaches its maximum of 23½° it makes an entire circuit of the horizon at latitude 66½°. You should be able to demonstrate this condition with a small globe.

(3059) J. M. asks: Can you give me recipe for making black preparation for filling brass engraved sign? A. Use black sealing wax melted into the engraving by heating the plate, then carefully scrape the surface and heat to glaze the sealing wax.

(3060) J. F. S. asks: Do you know of some chemical mixture, paste or process, to prevent steel from welding or sticking fast to wrought iron, when making a steel casting? The wrought iron piece is placed in the mould, and is used as a key, the steel is pored into the mould; at a temperature of 3,000° to 4,000°. The wrought iron key should be loose after the casting is made. A. Wash the key with a thick cream of porcelain clay and thoroughly dry before placing in the mould.

(3061) H. L. H. asks: Can you give me any directions for a formula for the preservation of flowers? I wish them to retain their shape and color as nearly as possible. I have tried alcohol, but they lose their color when exposed to the light. A liquid is preferable. A. It is difficult to retain all of the color. The best method is to dust salicylic acid on the plants as they lie in the press and remove it again when dry. Another method is to use a solution of 1 part salicylic acid in 14 of alcohol by means of blotting paper or cotton wool.

(3062) A. D. F. asks: What can be used to soften the first covering of linen that is gummed to the body of an Egyptian mummy, so as to remove the cloth without injuring or dissolving the skin? A. The mummy was embalmed with bitumen, which can be softened with chloroform. Proceed very slowly, gradually unwrapping the linen and applying the chloroform to the outside and to the place where the linen is stuck together on the inside.

(3063) C. D. P. asks: Please tell me how to loosen the sliding crooks of a horn when they become corroded. A friend of mine has a horn in which nearly all the crooks have become stuck and cannot be gotten out. A. Soak the joints of the horn with kerosene oil. If necessary blow some oil inside so as to reach the joints. If one crook can be got out, the oil can be put in through the opening.

(3064) J. B. writes: I would ask for a recipe to lacquer brass on doors. A. For lacquering brass.—Make the surface perfectly clean of grease or dirt. Lacquer with a thin solution of shellac in methylic alcohol, color with dragon blood gum to suit taste, and decant the clear lacquer. Use a camel's hair brush, and if possible heat the articles to about the temperature of boiling water.

(3065) C. F. K.—You will see articles on artificial stone and its manufacture in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 154, 325, and 355.

(3066) E. H. S. asks the various uses to which sand and borax are put, in the process of welding steel and iron. A. You will find an interesting article on welding in SCIENTIFIC AMERICAN SUPPLEMENT, No. 47.

(3067) E. J. H. writes: Mr. Werner Langguth, writing to the *Engineering and Mining Journal*, states that oxygen gas produced by adding a few drops of a cobalt salt to a strong solution of bleaching powder will be perfectly pure. Will not the gas be wet, and consequently contain traces of the chemicals in solution? If so, how can these impurities be removed on a small scale, inexpensively, so as to render gas safe for inhalation? A. Purify the gas by passing it through strong solution of caustic soda.

(3068) J. D. asks: What is the best gold dip for brass or fine gold lacquer? A. Gold dip for brass.—A thin decanted solution of shellac in methylic alcohol. Colored with dragon blood and saffron, more or less of either to suit your taste.

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May 26, 1891,

AND EACH BEARING THAT DATE.

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